THE

ELECTRICAL REVIEW.

VOL. L. JANUARY 17, 1902. No. 1,260.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

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MOTIVE POWER FROM BLAST FURNACE GASES.

As we have in the past devoted considerable space to articles on the utilisation of blast furnace gas, we think it will be well, after the lapse of a year, to give careful attention to a paper on the same lines, recently submitted by Mr. Bryan Donkin to the Institution of Civil Engineers.

The author naturally first considered the importance of the discovery, made within the last few years, that power could be effectively and economically developed from this abundant source, when employed through the agency of gas engines. Mr. Donkin, in giving the annual production of iron in the world as 40 million tons, did not attempt to show what measure of power could be developed by the gases which pass off from the furnaces producing this weight of iron. It generally requires at least 1 ton of coke, or its equivalent, to produce 1 ton of iron, and the volume of gas evolved during the consumption of this weight of coke is about 170,000 cub. ft.

40,000,000 tons per year = 4,566 tons of fuel per hour, and the volume of gas per hour issuing from the furnaces would be about 776 million cub. ft. Allowing 120 cub. ft. of gas per I.H.P.-hour, there would be, if the whole of this gas could be employed for power development, no less than 6,468,500 H.P.

This gas is partially used at the present time for heating the hot-air stoves, and for raising steam by combustion under boilers; however, at least four times the power developed by its use in steam boilers can be obtained by its direct employment in internal combustion engines. Mr. Donkin says that till within about half a century this gas had all been wasted; then, later, part was used in boilers and stoves.

Now that the gas can be turned to such profitable account, it is probable that there will be a great increase in the adoption of closed tops to the furnaces, where they do not already exist, and also the installation of gas engines will most probably be more rapid than was the case of the application of the gas to stoves and boilers.

Even when the gas is utilised for steam-raising and air-blast heating, there should be a considerable volume of gas available, after supplying the power requirements of the furnace; the adoption of gas engines for blowing and other power will very greatly increase the volume of gas available for profitable application.

For heating air-blast stoves the blast furnace gas is far from efficient owing to its low thermal value, while the dust it holds in suspension rapidly covers the surfaces to be heated with a very badly conducting material, besides clogging up the passages. Where the power can be fully and profitably applied, it will be more economical to employ common producer gas, from slack coal, for heating the stoves, and to use the blast furnace gas in gas engines. A high thermal efficiency can in this way

be obtained from blast furnace gas, poor as it is in combustible, while the gas from producers using slack coal will be much more efficient from a heating point of consideration, besides which, the stoves would seldom require cleaning, as the chief deposit would be carbonaceous, and this could readily be removed by burning.

The author said that with the present methods of utilising these gases, about 10 per cent. was lost by leakage, 28 per cent. was applied to heat the air blast, 40 per cent. to the boilers, and 22 per cent. was wasted, and went on to say that the power available had been calculated for English and Scotch furnaces at 2½ million H.P. per annum.

The author explained the reason why the power capable of being developed by gas of such low thermal value, in the cylinder of a gas engine, compared so favourably with the power from coal gas, as being due to the fact that blast furnace gas only requires about an equal volume of air for its combustion, while coal gas requires from five to six times its volume, thus permitting a larger volume of poor gas to be admitted in each charge; blast furnace gas, with the same proportions of cylinder, giving only 18 per cent. less power than coal gas.

In describing the composition of blast furnace gas, Mr. Donkin gave some typical analyses as well as thermal tests, but did not point out particularly that, given a certain class of ore, fuel and limestone charged into a furnace, the gas resulting is very constant in thermal value compared with ordinary producer gas, as we showed by diagrams in our issues of December 15th, 1899, and December 21st, 1900; out of 79 tests quoted, the maximum difference was only about 6 per cent.

There appears to be little doubt that the most important point in the application of blast furnace gas to internal combustion in gas engines is the removal of the dust carried by the gas from the furnace, and where the gas is properly purified, the other troubles are not very difficult to overcome.

The low thermal value of the gas permits of increased compression and higher efficiency, and perfect ignition can be obtained by either an electric spark or a heated tube when the temperature of the latter is properly regulated and under control.

Mr. Donkin gave a *résumé* of tests carried out on engines working with blast-furnace gas, and these are all very satisfactory. Though these tests have mostly been made on the Continent, they are not the only indications of the progress which has been accomplished.

The electrical power installation at Sheepbridge Ironworks, where the gas is treated by the Thwaite-Gardner system, and which we fully described in our issue of December 14th, 1900, has been duplicated, and from the daily Press we learn that at Clay Cross, in the same district, a blowing engine was started on December 16th, 1901, on the same system.

Mr. Donkin refers briefly to a blast furnace gas-driven blowing engine at Wolverhampton, but we notice that the blowing engine at Clay Cross is a departure from other systems in that the air cylinder is placed vertically above the crankshaft of the gas engine; also the air valves, to allow of the high piston speed, are of the piston type, positively moved by eccentrics, balanced, and noiseless.

We gather from the paper that at the end of last year there were working, or under construction, blast furnace gas engines of an aggregate power of about 65,000 H.P., and when we take into consideration that the first engine was started in 1895, the progress in this application is highly satisfactory. The displacement of a steam engine at an iron works by a direct driven gas engine renders available at least three times the power of the engine, if the spare gas is used in gas engines, for the production of cheap electrical power, and it is in the interests of both blast furnace proprietors and electricity consumers to combine for the purpose of developing the economy of the blast furnace and electrical processes.

London Telephones.

THE adjourned conference of representatives of local authoritatives was held at the Guildhall on Monday, with Mr. A. C. Morton in the chair. A letter from the Postmaster-General was read. In this he replied generally to the resolutions agreed to at the previous meeting of the conference, traversing the main features in a temperate and straightforward manner. He reminded the conference that, as regards the rates of charge, the Select Committee reported that the then existing rates of the National Company for unlimited service could not be considered unduly high, yet the new scale makes a reduction in this rate to the one-year subscriber. The message rate being an untried experiment in London, it was necessary to take precautions against loss to the ratepayers by fixing at the outset rates which might, in due time, be reduced, but which it would not in any probable circumstances be necessary to raise. The conference did not find any satisfaction in the Postmaster-General's letter, and proposed to let the Lord Mayor bring the subject before Parliament. One speaker (Mr. Finch, of Marylebone) had the temerity to express his belief that the agreement made by Lord Londonderry was the best that was possible in the circumstances. He was opposed to people being provided with a telephone at less than cost price, leaving the taxpayer to make up the loss. The next speaker promptly asked him if he were a shareholder in the National Company, receiving a reply in the negative; and another Marylebone representative remarked that Mr. Finch did not represent the views of Marylebone on the subject. From this it is apparent that the ratepayers of Marylebone are thirsting for the opportunity of paying for other people's telephones out of the rates, and that some members of the conference cannot understand how anybody can regard the agreement as satisfactory unless he be financially interested.

Electric Traction.

IT is impossible to press home too often the absolute necessity for Parliament to remove as speedily as may be the legislative restrictions which have for 30 years past obstructed the path of tramway progress in this country. Sir C. Rivers Wilson in his address to the Tramways and Light Railways Association last week referred to the paramount national importance of the electric traction industries, and showed how active his Association was in endeavouring to get wrongs righted. No one will be more ready than the ELECTRICAL REVIEW to thank the Association and its members for their very valuable work. As an organisation they are very young as yet, but already most of the leading electric tramway promoters, officials, and some manufacturers have lent their aid, and during the coming year the Association will be very much to the fore. By the help of the Light Railways Act, our promoters and engineers have been enabled to trample across some of their difficulties, and it is satisfactory to find that the latest figures show that there are 777 miles of electric tramway actually constructed, 533 miles in course of construction, and 927 miles authorised and about to be constructed. We have here a total of 2,237 miles, which, if we may use the expression, form a monument to the enterprise and determination of those to whom we are indebted for the awakening of the industry. Last year it was stated that the total miles of horse, steam, and electric tramways in operation in the United Kingdom was only 1,200 miles. This figure only needs to be placed beside those given above to show what a great change electrification is going to produce in the travelling facilities of the British public. The Council of the Tramways and Light Railways Association has been changed by the election of the following to fill certain vacancies:—Messrs. T. O. Callender, C. H. Gadsby, Hugh C. Godfray, F. J. Trewitt, A. M. Wilcox, and Thomas How. Mr. George Offor has accepted the position of honorary auditor.

THE CORBIN PROCESS AND CELL FOR THE ELECTROLYTIC PRODUCTION OF CHLORATES.

By JOHN B. C. KERSHAW, F.I.C.

The Corbin process and cell for manufacture of chlorates by electrolysis have been operated at Chedde, in Savoy, since 1896. The Chedde works are owned by the firm of Corbin & Cie., and 12,000 H.P. have been developed at this place by hydraulic engineering works of an extensive character. Owing to the variations in the amount of water passing down the River Arve, caused by the melting of the

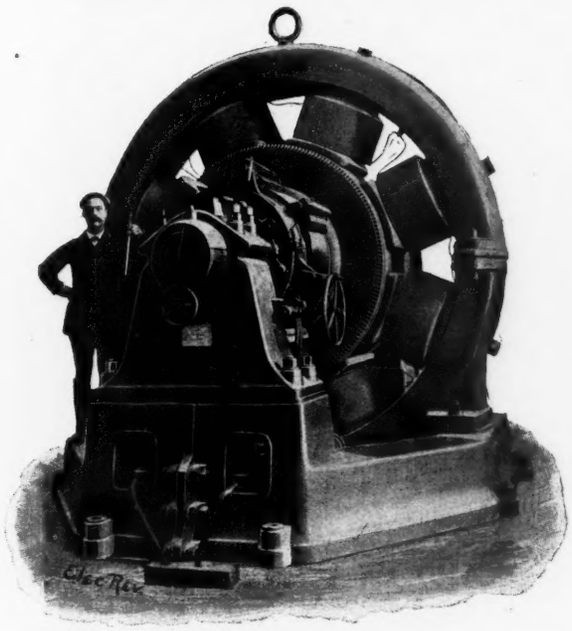


Fig. 1.

winter's snows upon the High Alps, the mean annual power utilised is only two-thirds of the above, or from 8,000 to 9,000 H.P.

Above the ravine of Chatelard, the power furnished by the Arve is used for the operation of the electric railroad connecting Chamounix and Fayet. Below the first generating station the water is again enclosed in a tunnel 700 metres in length, and is conducted to a point on the mountain side 140 metres above the river bed at Chedde. From this point two steel pipe lines, each 1·40 metres in diameter, carry the water down to the turbine house.

These pipe lines are each 600 metres in length, and are carried over the River Arve by a specially constructed bridge, shown in fig. 2.

The total length of the galleries and tunnels carrying the water to the Chedde turbine house is 1,790 metres; the sectional area of these tunnels lies between 5 and 30 sq. metres, while the flow of water varies from 5 cubic metres per second in autumn and winter, to 8 cubic metres during the spring floods.

The turbine house is a narrow building, 120 metres in length, and contains 12 turbines, each of 1,000 H.P., running on horizontal shafts.

The dynamo house adjoins the turbine house, is of the same length, and is equipped with 12 Oerlikon dynamos, each direct coupled to one of the 1,000-H.P. turbines. Fig. 1 is a view of one of these Oerlikon dynamos.

The building containing the chlorate vats is 130 metres in length, 60 metres broad, and 21·5 metres in height; but this is only one of the numerous buildings at Chedde, and the whole works covers 13,000 sq. metres of ground. Fig. 2 is a bird's-eye view of the works.

The Corbin type of chlorate cell is shown in vertical section in figs. 3 and 4. The cell is built of cement, and contains a large number of secondary electrodes, B, C, held in position along the centre of the vat by the two fixed supports, A and H. Each of these secondary electrodes is composed of a wide ebonite frame, B, in the centre of which a thin sheet of platinum foil, C, is fixed by screws, as shown in section in fig. 4.

These secondary electrodes are held upright and about 15 mm. apart, in grooves along the inner side of the central supports A and H. The electrolyte entering the vat at O, passes between these electrodes in an upward direction, as shown by the arrows, and flows away over the edge of the vat at Q. Fig. 4 shows the arrangement adopted for obtaining electrical connection with the two end electrodes. Each of these consists of a thick plate of metal, S, covered with platinum foil and held in position against the end of the vat by the bolt and nut, R and W. A narrow band of rubber insulating material, T, is placed between the metal plate and the end wall of the vat, and leakage of the electrolyte at R is thus prevented. The terminal electrodes, S, are placed in the exact line of the platinum centres of the secondary electrodes C, C, C, &c., and the superficial dimensions of the active surface of each of the electrodes are the same. The object of the wide ebonite frames is to prevent straying of the electric current in its passage through the vat, and this device for keeping the current to the line of secondary electrodes, is the chief claim of the two Corbin French patents of 1892 and 1894.

The chemistry of the electrolytic process for chlorate production need not be dwelt upon here,* and it will suffice to say that the Corbin type of cell appears to be well designed for bringing about the reaction between chlorine and sodium hydrate, upon which the formation of chlorate depends.

The current efficiencies of the various electrolytic cells for chlorate production, based on the figures published in the early days of the manufacture, have varied between 35 and 52 per cent.,† but recent laboratory investigations by Oettel, Müller, Foerster, and others have proved that far higher efficiencies than these can be obtained, if the reducing action of the hydrogen liberated at the cathode be suppressed. The addition of alkaline carbonates, of calcium chloride, and of potassium chromate to the electrolyte, have been recommended for this purpose, the theory with regard to the use of the two latter being that a thin skin of calcium or chromium hydrate is formed over the cathode, and that this acts as a diaphragm in the cell.

Though exact information is not available, it is probable that one or other of these additions to the electrolyte is now

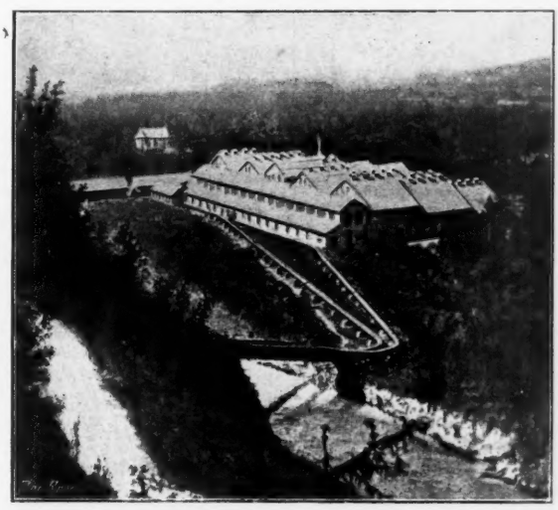


Fig. 2.

adopted in the Chedde electrolytic chlorate works, for in a recent letter to the writer M. Paul Corbin states that a current efficiency of 85 per cent. is attained in the process,

* For details of the process see the *Electrician*, February 19th, 1897.

† *Engineering and Mining Journal*, New York, June 10th, 1899.

and that it is hoped ultimately to attain one of 90 per cent.

The output of chlorate and perchlorates by the Chedde Works has increased from 2,200 tons in 1899 to 4,000 tons in 1900—a very large total when one considers that in

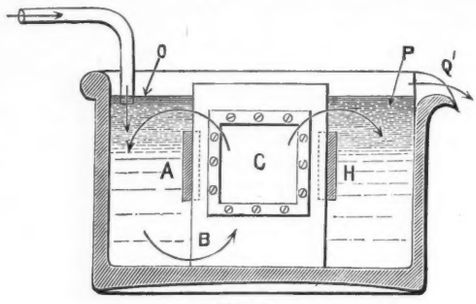


FIG. 3.

1899 the world production and consumption of chlorates was estimated to be only about 9,000 tons. The consumption has, however, rapidly grown, and the chlorate and perchlorates produced at Chedde are largely used in the manufacture of a new explosive called "Cheddite," patented by MM. Bergés and Corbin, the chief partners in the Chedde firm. Factories for the manufacture of this explosive have been established in France, Switzerland, Greece, and Italy, and a new outlet for the products of the Chedde works has thus been created.

The surplus chlorate is reported to be sold in Germany, Italy, America, and Japan.

The Chedde works were represented by an interesting exhibit at the 1900 Paris Exhibition, and a gold medal was obtained for the products shown. It is an instruc-

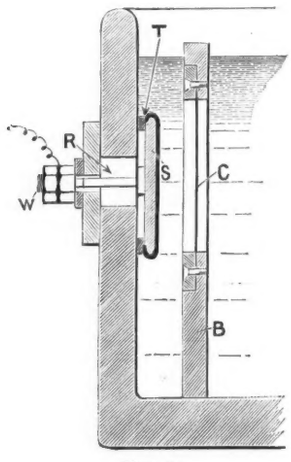


FIG. 4.

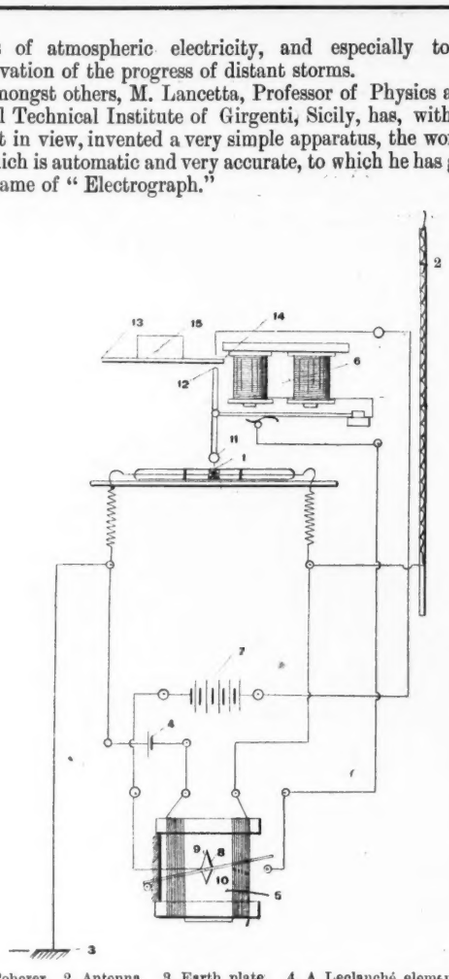
tive and interesting fact in connection with this firm, that a research laboratory is maintained, and that three chemists are employed in experimental work bearing on developments and improvements of the processes used in the Chedde Works. Perhaps the rapid growth of the undertaking is in a large measure due to this readiness to examine new ideas and inventions, relating to the manufacture and utilisation of chlorates and other products of similar chemical composition.

NOTE.—The laboratory investigation by Brochet, of the conditions obtaining in the electrolytic chlorate cell, proved that the addition of chromates to the electrolyte *diminished the reduction losses* at the cathode 87 per cent.

THE "LANCETTA" ELECTROGRAPH.

SEVERAL scientists of various nationalities have applied the property of imperfect contacts to the registration of disturbances of atmospheric electricity, and especially to the observation of the progress of distant storms.

Amongst others, M. Lancetta, Professor of Physics at the Royal Technical Institute of Girgenti, Sicily, has, with this object in view, invented a very simple apparatus, the working of which is automatic and very accurate, to which he has given the name of "Electrograph."



1. Coherer. 2. Antenna. 3. Earth plate. 4. A Leclanché element. 5. Galvanometric compass. 6. Bell. 7. Battery elements. 8. Pivot of the needle, 9—10, of the galvanometric compass 5. 11. Coherer hammer of the armature of the bell 6. 12. Pencil or pen of the armature of bell 6. 13, 14. Dial on which the hours are inscribed backwards. 15. Clockwork mechanism working the dial 13, 14.

FIG. 1.—DIAGRAM OF CONNECTIONS.

The apparatus really consists simply of a receiver, as the transmitter is sometimes the lightning which telegraphs "I am here," and sometimes the atmospheric electricity, which manifests itself in the form of a current, going from the top of the antenna to earth through the coherer.

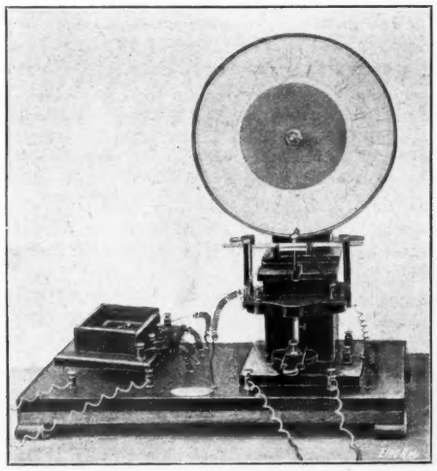


FIG. 2.

The receiver, *i.e.*, the Lancetta electrograph (figs. 2 and 3) only differs from the ordinary receivers used in wireless telegraphy in its registering apparatus. The latter consists of a

bell, the armature of which is provided on one side with a little hammer, which decoheres the imperfect contact, and on the other with a pencil or a pen, which registers on a dial set in motion by clockwork. The movable dial shows the hours like an ordinary clock, with the difference that the index represented by the pencil or the pen is fixed, while the dial revolves, completing its revolution in 24 hours. This is why the hours are inscribed on the dial in the reverse order to that used for ordinary clocks. When the coherer is influenced and rendered conductive by a flash of lightning, for instance,

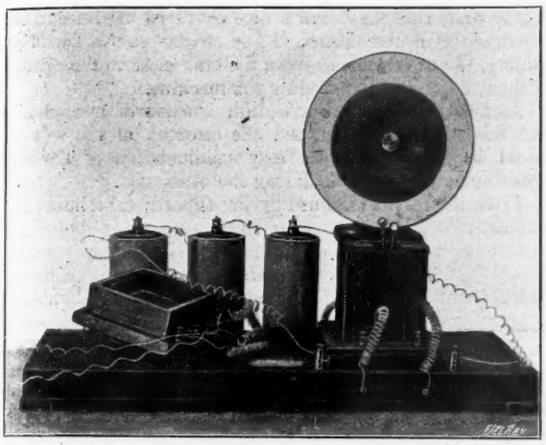


FIG. 3.

the bell rings, the length of the sound depending on the duration of the flash; at the beginning of it the pencil marks a point on the dial, and at the return movement of the armature the little hammer decoheres the sensitive tube.

The galvanometric compass employed by M. Lancetta is highly sensitive.

Every 24 hours the apparatus has to be examined by the attendant in charge, who also winds up the clockwork mechanism and changes the sheet of paper on the dial. The observer notices whether there are on the dial any signals produced by the lightning, and, if so, he makes a note of them, and also of the time at which they were registered. In this way, by the aid of several of these observations, diagrams can be constructed like that shown above, which relates to flashes of lightning registered by the Lancetta electrograph at the Girgenti Observatory during September, 1901.

The Lancetta apparatus is already in use in several observatories in Italy, and might be of great service in stations of artillery for averting hailstorms. By adding a second bell one could receive immediate warning of the registration of a signal, and thus be enabled to follow the course of a storm.

Rings at comparatively long intervals would mean, *the storm is in sight*, which amounts to *probability of a storm in a few hours*.

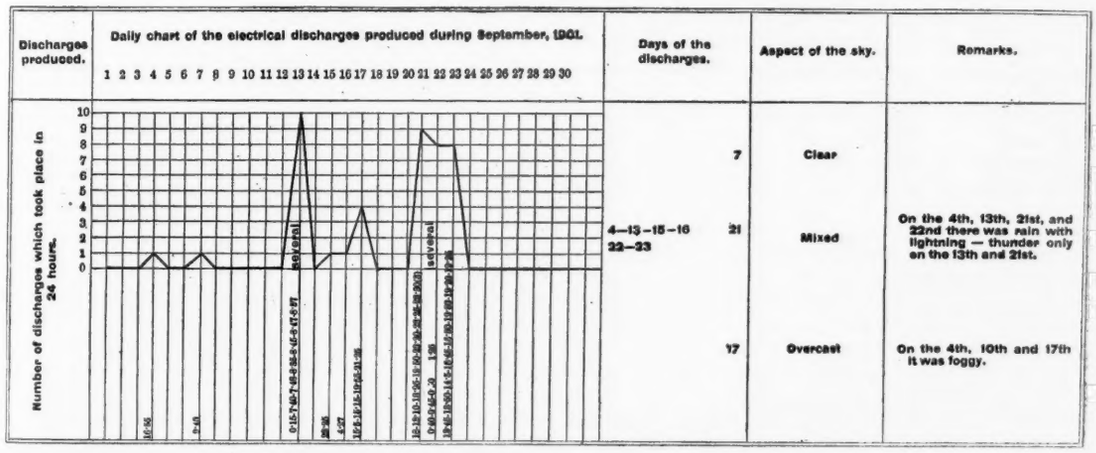
Rings becoming more frequent mean, *the storm increases in intensity, or grows nearer*, and from this may be concluded, *the probability of a storm is greater*.

When the signals get less frequent after an acceleration it means *the storm is getting further away or decreasing in intensity*. From this we may conclude *the storm will not reach the place of observation*, or at any rate, *there is no danger for some hours; at the worst there will only be rain or a change in the weather*.

The distance to which storms can be signalled by this apparatus depends on the height of the antenna, on the altitude, on the surface, on the force of the atmospheric discharge, on the distance from the apparatus, and on the height at which it takes place. With an antenna of six metres, placed on an elevation and without any surrounding obstacles, this distance is 100 km.

METEOROLOGICAL OBSERVATORY OF THE ROYAL TECHNICAL INSTITUTE OF GIRGENTI (SICILY).

Diagram of the electrical discharges registered by the Lancetta Electrograph.


Discharges produced.
Daily chart of the electrical discharges produced during September, 1901.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Number of discharges which took place in 24 hours.
10 9 8 7 6 5 4 3 2 1 0
several
several
several
Days of the discharges.
4—13—15—16
22—23
Aspect of the sky.
7 Clear
21 Mixed
17 Overcast
Remarks.
On the 4th, 13th, 21st, and 22nd there was rain with lightning — thunder only on the 13th and 21st.
On the 4th, 10th and 17th it was foggy.

The numbers marked in the diagram show the time of the discharges.

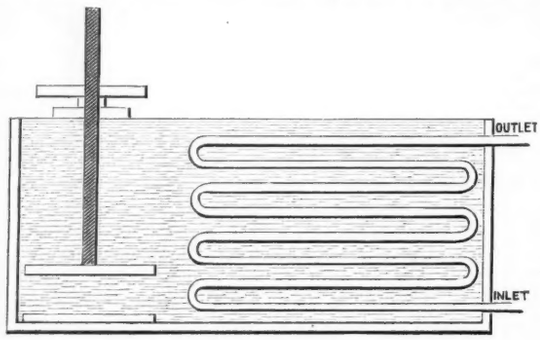
AN IMPROVED TESTING TANK.

IN nearly every case when tests of dynamos are made lasting 6 or 12 hours, the electrical power generated cannot be usefully employed, but has to be dissipated by means of either a wire or water resistance, the use of water resistances has become more and more prevalent, owing to the ease with which these can be put down for tests after the machines have been delivered and fixed in the purchaser's works, and also because of their adaptability for any E.M.F. or current.

As is well known to every electrical engineer, the usual form of testing tank consists of a wooden tank, in which there are two electrodes of large area, to which the positive and negative leads are attached; the electrolyte consists of a weak solution of either common salt or washing soda, the latter being frequently used, as the plates are not so liable to become furred. From Ohm's law we know that the amount of current which passes will depend inversely upon the resistance between the electrodes. Now, the area of the electrodes being constant, the resistance will depend upon the distance apart of the electrodes, and inversely upon the strength of the solution. Since it is impossible to increase the strength of the solution beyond saturation point, the resistance of the circuit is varied by altering the distance between the plates, this alteration being effected by screw gear. Another form of resistance tank consists of an iron tank, the tank itself forming the negative electrode, while the positive electrode consists of a metal plate which is immersed in the middle of the electrolyte. This is generally supported by two chains fixed to a barrel; and the resistance is in this case varied by immersing more or less of the positive plate

into the electrolyte. In either of these cases the requisite load can be obtained, and any necessary adjustment can be quickly and easily made *so long as the temperature of the electrolyte* remains below boiling point.

In accordance with the law of the conservation of energy, the mere passing of the current through the solution would not dissipate the electric energy, and it is evident that the current in so flowing must do some work. This work consists in raising the temperature of the electrolyte. Now, we know that in order to raise the temperature of 1 lb. of water 1° F., we require 778 ft. lbs., and a large generator working at full load will soon supply sufficient energy to raise the temperature of the electrolyte in any tank of ordinary dimensions to boiling point. When this temperature has been reached the troubles of the tester begin, owing to the evaporation which takes place; the level of the water rapidly falls, and with vertical plates the area is reduced, so that the load decreases owing to the



Improved Testing Tank.

increased resistance. The tank is then filled up with pure water, but the load does not come back to the normal, owing to the decreased density of the solution, so some more salt is thrown in; probably the solution is made too strong for the area covered, there is a certain amount of overloading, and the maximum circuit breaker flies open. This is an experience which the writer believes every tester will have had ample opportunities of finding correct. But the troubles do not end here; boiling is still continued, and the resistance is consequently being constantly varied, while, to add to the inconvenience, in order to protect the dynamo from the pernicious influence of the rising steam, the tank has to be placed outside the building, and the operator has to shout his orders for more salt, or more water, to his assistant some distance off. The management of the tank generally resolves itself into allowing a continual flow of cold water into the tank, and the throwing in of a handful or two of salt or soda from time to time. The result is a sloppy affair, wet underfoot, wet steam all around, and anything but a constant and steady load.

In order to overcome these disadvantages, Mr. H. Lindley, manager of Messrs. Galloways, Limited, Knott Mill Engineering Works, Manchester, has brought out a new form of tank. Messrs. Galloways have lately commenced building high speed engines to be direct coupled to dynamos, and Mr. Lindley, having decided to adopt the use of water resistances when testing the combined plants, sought for some method of obtaining all the advantages of a water resistance, while, at the same time, avoiding the disadvantages, and obtaining, during the whole test, perfect control of the load.

Mr. Lindley's arrangement consists of an ordinary wooden tank, which is made longer than is required by the length of the electrodes. As shown in the sketch, he employs horizontal electrodes. These are made of cast-iron, and are cast with a large number of holes through them. The object of these holes is two-fold, viz., in the first place to permit of the free circulation of the electrolyte, and to permit also of the upper plate, which is adjusted by means of a screw, being moved easily either up or down. These electrodes occupy about one-third of the length of the tank; the remaining two-thirds is occupied by a cooling device. This arrangement is identical in construction with that of a water heater, and consists of a number of copper tubes connected in series with each other. Cold water is forced through these tubes, and the quantity so flowing is regulated by means of a valve, or a pump may be added if it is necessary to greatly increase the flow. Upon making a trial of this tank when 700 amperes at 220 volts had to be dissipated, it was found possible to maintain the temperature of the electrolyte for the whole period of the test—viz., six hours—at approximately 208° F., and in this case the supply of cooling water was somewhat restricted; the temperature of the circulating water taken as it left the exhaust pipe was 202° F., or 6° F. only below the temperature of the electrolyte in the testing tank. The circulating water being clean, could, if necessary, be used for feeding the boiler, although in this particular case it was allowed to run to waste; as the exhaust pipe conveyed the circulating water to the nearest drain and the electrolyte was kept from boiling, it was possible to place the tank close to the dynamo without any fear of damaging the machine.

At 208° F. there was a certain amount of evaporation, but this was only slight, and the strength of the solution could be kept constant; easy manipulation of the load was therefore practicable during the whole test.

From the results obtained during this one experiment it is evident that it would be practicable to arrange a portable tank to deal with any current, since with larger powers it would only be necessary to increase the number of coils and the amount of circulating water in order to maintain a temperature in the tank of under 212° F.

There is one question which arises in connection with this arrangement, and that is, in what direction should the water flow through the cooling coils. We know that the heated electrolyte tends to rise to the surface, and therefore the upper layers are those which require the most cooling and should have the coolest coils immersed in them. On the other hand, the source of heat is at the bottom of the tank, and it is here that it is necessary to keep down the temperature. If the circulating water flows from the top coils to the bottom it will probably get too hot before it reaches the lower layers to have any very marked effect; if it flows the other way little will be done towards cooling the upper layers. The difficulty might be got over by having two sets of independent coils, and having the flow in opposite directions; in the case under consideration the water was made to flow from the bottom to the top coils, and the result obtained was for the amount of circulation water used quite up to expectation.

Since this trial was made, a second test has been carried out; the flow was still kept from bottom to top, but the quantity of the circulating water was increased; 300 kw., viz., 600 volts and 500 amperes were dissipated for six hours continuously, the maximum temperature of the electrolyte being under 200° F.

METHODS OF ELIMINATING CORRECTIONS FOR THE LEADS, &c., IN CABLE TESTING.

By H. Savage.

Owing to the fact that cables and insulated wires usually have to be immersed in tanks for testing, the tanks being distant from the test room, and, in the case of telephone cables, have a large number of ends, it is practically impossible to connect the conductors directly on to the testing apparatus. It is therefore necessary to insert between the instruments and the cables an insulated conductor, or conductors, known as the "lead," or "leads." Before proceeding to apply any test to the cable, we must first apply the test to the leads, so that their value may be deducted from the subsequent observations, in order to ascertain the true value of the cable. In the case of capacity tests, where the relative charges of a cable and standard condenser are compared by the swing of the galvanometer needle, it is usual first to note the deflection due to the lead, and then to subtract this deflection from that obtained when the cable is connected up. For the sake of accuracy the deflection on the lead is taken with the galvanometer open (*i.e.*, unshunted), and this deflection is then divided by the multiplying power of the shunt used on the cable. Thus if the deflection on the lead with galvanometer open = d, deflection of cable with galvanometer shunted = D, true deflection on

cable = D_t, and the multiplying power of the shunt = n, then $D_t = D - \frac{d}{n}$. While this is correct for the simple shunt arrangement, as in fig. 1, it is not strictly correct when a shunt of the universal type is used, if the leads from the keys, &c., to the galvanometer have any appreciable capacity. As the galvanometer is often placed at some distance from the test table, and the leads run under the floor or along a wall to be out of the way, a certain length of wire is introduced into the circuit, whose capacity may cause a considerable error, especially if the capacity of the condenser or cable under test be small. The deflection on the lead is the sum of two quantities—viz., d_{gl}, the deflection due to the galvanometer leads, and d_{tl}, the deflection due to the testing lead. In fig. 1, G is a galvanometer

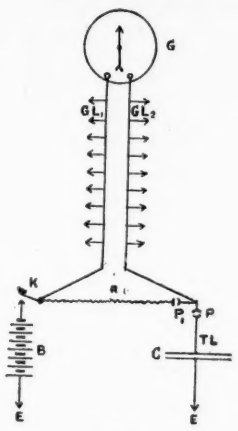


FIG. 1.

connected by leads, G L_1 and G L_2. T L is a testing lead to C, a condenser or cable, whose capacity is to be measured by the simple charge method. B is a battery, which can be applied to the circuit by a key, K; P is a plug or switch for shunting G with an adjustable resistance R. As the galvanometer leads and testing leads are both shunted by R, then $D_t = D - \left(\frac{d_{gl} + d_{tl}}{n}\right) = D - \frac{d}{n}$. In fig. 2, R is replaced by a shunt on the universal principle, a common value for its resistance being 10,000 ohms. Here we see that as n is varied by tapping

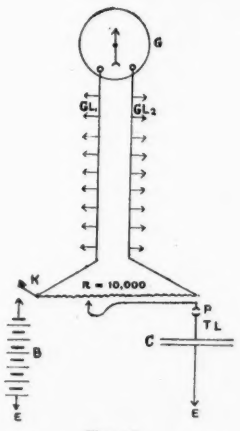


FIG. 2.

R at various points the testing lead is shunted by a varying ratio, but this has no effect on the galvanometer leads. Thus d_{gl} remains constant while d_{tl} varies inversely as n, or $D_t = D - \left(d_{gl} + \frac{d_{tl}}{n}\right)$. For instance, suppose that before the testing lead is connected to the instruments K is depressed and a deflection of 3 scale divisions is obtained, due to the capacity of the galvanometer leads, and when the testing lead is added 100 divisions is obtained, and that the shunt to be used on the cable is $n = 100$, then the amount to be deducted from D in the case of fig. 1 = $\frac{100}{100} = 1$, and in the case of fig. 2 = $3 + \frac{97}{100} = 4$ nearly. The best plan is to check the value $\frac{d}{n}$ by testing the total deflection on the leads for each value of n used.

In using the universal shunt care must be taken to see that the connections are made as in fig. 2, that is, the current must enter at one terminal of the fixed resistance R. Almost all shunts of this type have three terminals, a single one connected to one end of R and marked "G" for one of the galvanometer leads, another one connected to the commutator bar, switch, or sliding contact, and marked "L," for the testing lead, and a double terminal connected to the other end of R, and marked "G L," for the second galvanometer and testing leads. Whether testing by simple charge or by discharging, the current should split at the double terminal. If the connections are reversed as in fig. 3, d_{gl} will

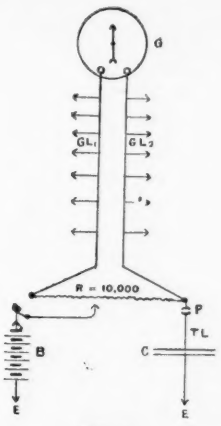


FIG. 3

vary. When $n = 1$, d_{gl} will be a maximum, and as the position of the slider or switch is varied it will diminish until at the middle position, where $n = 2$, it will be zero. If d_{tl} is small and n has a high value, due to the condenser or cable having a large capacity, the total deflection on the leads may be a negative one; that is to say, when testing the leads, by varying the position of the sliding contact, deflections may be obtained on opposite sides of zero. A good plan to avoid this difficulty is to put the galvanometer reverser between the keys and the shunt, instead of between the shunt and the galvanometer, as is often done.

The connections should then be arranged so that when testing by simple charge, the current passes through the reverser to the double terminal of the shunt box. The leads may be adjusted on the galvanometer terminals, in the first instance, so as to produce the deflection in the most suitable direction. If it is desired to test by discharges or to alter the sign of the current in an insulation test, the reverser will keep the current in the same direction in the shunt, as is the case with the galvanometer.

The correction for the testing lead always introduces an element of uncertainty and limits the degree of accuracy of cable tests. This is small in the case of insulation tests, where the insulation of the cable is very low compared with the lead, but may be considerable where it is very high. In measuring electrification by calculating the percentage difference between the first and second minutes' readings, if the difference is small, the lead introduces a considerable element of uncertainty. Loss of charge tests are also affected by the same cause. Again, in looking over records of tests, one has often to check the calculations to see if the leads have been allowed for. Owing to these difficulties, the writer tried various methods of eliminating the corrections for the leads altogether, and finally adopted an extension of Price's guard-wire system.* This system was first introduced to

* See ELECTRICAL REVIEW, December 6th, 1895.

eliminate surface leakage on ends of cables when the latter were under test. The writer has shown how the same principle may be applied with damp and leaky instruments.*

In the present instance the guard is applied continuously along the whole length of the testing lead.† This is accomplished by using a lead with a surrounding or concentric conductor which is also insulated. The inner conductor is joined in circuit with the galvanometer, while the outer conductor is connected direct to the battery. As the inner and outer conductors are at practically the same potential, there will be no leakage between them, either radially or over the ends, and consequently there will be no deflection on the galvanometer.

(To be continued.)

NOTES ON THE CABLE INDUSTRY IN GERMANY.

By MERVYN O'GORMAN.

Protection by Patents.—It is to be remarked that the German patent system, in spite of its more elaborate methods, its examiners and its search for priority, &c., is not apparently any better able than our own to make possible the publication of inventions based upon the mixing of compounds for insulation or other purposes. It is admitted that the discovery of chemicals or mechanical mixtures having peculiar electrical qualities is of great use, and that publication would lead to more rapid progress than secret recipes and compounds, but it is disappointing to find that most cable factories have to resort to secret processes, to which are given various and peculiar names, such as "Stabilit," "Kabelit," &c. As far as could be observed on any working cables (apart from experimental samples), the thickness of dielectrics for a given maximum voltage was not noticeably less than the recognised thickness in this country, and as this is the chief direction in which economy is to be looked for, there is no sign of our being behind. Further, the universal prevalence of the lead covering shows that no waterproof substance has yet been found.

One sample of lead-covered Stabilit cable subjected to a very high pressure was shown, and this certainly had a remarkably small capacity, and yet a small thickness of insulation for the voltage used. I only know of one smaller result having been obtained in this country, but in the absence of data as to the cost of preparing the material in question (material which may have been more expensive in quality than that commonly sold), we need not at present fear for our superiority in cable making. Nevertheless, in the near future the new German cable factories, such as Siemens and Halske and the Allgemeine Elektricitäts, are likely to be keen competitors with any cable maker here, for several reasons :—

1. The cheap rate of highly skilled technical labour.
2. The fact that it frequently pays to import Westphalian copper to London for cable making.
3. The fact that only technical and physical impediments have to be met in Germany to the reduction of insulation thickness, and that there is apparently no legal compulsion to use a supplemental conducting armour inside or outside the lead sheath of "extra high tension" cables. Furthermore, there do not appear to be any restrictions as to the allowable size of a cable shop, a matter in which at least the London Building Acts hamper some of our manufacturers.
4. The remarkably good grip of certain technical difficulties :—

(a) Whereas the weakness of high tension insulations has, up to the present, been chiefly due to unavoidable dirt in manufacture, precautions of extraordinary elaborateness have been made to obtain cleanliness. Every machine head which is served by a compounding tank has an individual cowl and chimney. Special precautions are taken to remove volatilised hydro-carbons from the impregnating tanks, and fumes from the lead pots, which besides are frequently heated by petroleum fuel to avoid the presence of ash and dust.

(b) Great floor space is allowed, and excellent illumination and ventilation. All these tend in the same direction.*

(c) Electric driving again is a great help in keeping down dirt and dust, and the number of belts is less than in most English factories, even when motor driven.

(d) Jute and yarn, cotton, &c., are as far as possible used from the spool on which they are delivered, instead of being rewound on to special bobbins for the machines. (This, however, is currently done in England.)

Vacuum Drying.—The essentially technical improvement in which the German cable industry is slightly ahead of ours, is the adoption of vacuum drying, and vacuum impregnating tanks.

By means of large cast-iron chambers, which are steam heated, it is possible to remove all the free moisture from cellulose and similar material without ever raising the temperature higher than 105° C., and therefore without producing any of the partial decomposition of the cellulose which invariably attends heating at the usual 240° F. for lengthy periods in English cable factories. Decomposition of the cellulose by heat apparently depends on time, and the time for perfectly drying high tension cables by the vacuum process is reduced from about 70 hours to about 10 hours. This fact further enables a small vacuum drying chamber to deal with many times the amount of material that can be handled by a heated and ventilated chamber of the same dimensions. The hygroscopic state of the air in the drying chamber is indicated at any moment by a continuously reading indicator, and the superior strength of the fibre which has not undergone the preliminary roasting may be expected to give valuable results.

As practised in certain German works, vacuum drying is by no means mechanically perfect, and unnecessary labour and some loss of time appear to result from coiling the cable on flat shallow trays, without any very apparent advantage over the skeleton iron drum more usual here. This practice originally arose from the drying machines being primarily designed for sugar and confectionery purposes. When we adopt the vacuum principle these minor errors may be avoided.

Wire Drawing.—A technical step, which is allied to financial policy, and which probably would have shown better results had the Institution visit not been made at a time of great industrial depression, is the means adopted for reducing the very large stocks of copper wire which cable makers have to carry owing to the large number of different sizes and styles of cable required. Stocks of £30,000 and £50,000 worth of material have appeared as assets in English cable works on such occasions as they have published statements regarding their financial position (*e.g.*, when issuing a prospectus).

By installing wire-drawing mills and purchasing only one or two stock sizes of copper wire, the variety of demand may be met without the delay of waiting for the wire drawers' delivery, and yet without carrying a multiplicity of different sizes in large quantity. Furthermore, there is an incidental economy on the operations of winding and measuring.

Bobbins and Reels for Factory Use.—It was clear that the rapid variation in the class of cables sold or other causes had not allowed of the standardisation of the sizes of the bobbins and reels. This was the more surprising as the cable works visited were comparatively new. On the other hand, money seemed to be no object, and this may have led to a somewhat wasteful neglect of the fact that bobbins and reels represent a very considerable lock-up of capital. This defect is equally noticeable at home, but is as a general rule due to very different causes, such as the old established nature of the business, and the amount of pioneer work effected here.

The Standardisation of cable sizes adopted in this country by the Cable Makers' Association, which will eventually be an economy not only to themselves, but to the makers of switchboard castings, pipes, conduits, &c., has been followed by a

* See Electrical Review, September 3rd, 1897.

† This method was also independently described by Messrs. Ayrton and Mather before the Physical Society, January 26th, 1900. See Electrical Review, August 24th, 1900

* Though the output of the A.E.G. cable works at Oberspree is for five lead presses, the floor space is 10,400 metres.

similar adoption of standards in Germany. The point of interest here is, however, that the body which corresponds to the I.E.E. (the Verband Deutsche) is a party to the standardisation. The Joint Committee passed the resolution while the I.E.E. were at Dresden.

In general, the German cable industry is not ahead of ours, but the seeds of important advance have been sown.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"St. Stephen" writes:—"We shall esteem it a favour if you can give us some information as to the powers possessed by a Corporation, that is:—Have they the power to forbid the erection of overhead wires over a street or streets for the purpose of lighting a branch establishment, by a firm having a private plant, or wishing to supply other firms from such private plant? We have an idea that it was stated in an electrical paper, the name of which we cannot recall, that such a body had not the power, but are not quite sure on the point.

"The case in point is that a large firm in ——— who have several establishments on two sides of a street are anxious to connect same by means of overhead wires, and we are anxious to know if such wires can be fixed without the permission of the Corporation.

"If you will kindly give us this information we shall be obliged."

*** We assume that the district in which our correspondent's works are situated, is outside the Metropolis. If this be so, then so far as we are aware, if the cables in question are placed at a sufficient height above the street, the local authority will have no power to interfere. This point has been decided in relation to telephone wires. In the case of Wandsworth District Board of Works *v.* The United Telephone Company, Limited, 13 Q.B.D. 904, the telephone company had placed wires fixed to the chimneys of certain houses, and, therefore, above the level of the roof of the houses. If the wires had been a nuisance to the highway, *e.g.*, if they had been dangerous to the use of the street, the Court held that the Board of Works might have obtained an injunction. The Court, however, held that in this particular case the wires in question were so high above the surface of the road that they did not interfere with the use of the street as a street. They, therefore, refused to allow the Board of Works to interfere with the wires.

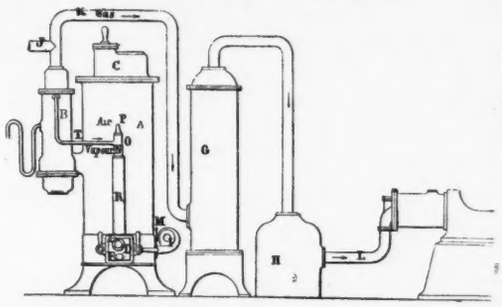
The same principle was adopted in the recent case of the Finchley Electric Lighting Company, Limited, *v.* the Finchley Urban District Council, which came before the Lord Chief Justice in the Long Vacation last year. There the plaintiff company supplied electricity to private consumers without provisional order or special Act. They placed certain of their mains across the highway in the manner which our correspondent proposes to adopt. The local authority sought to remove the cables over the highway on the ground of nuisance, but the Court granted an injunction to restrain them from so doing. Curiously enough, if our correspondent were acting under provisional order or special Act the consent of the local authority would have to be obtained.

A NEW SYSTEM OF POOR-GAS PRODUCER.

The Taylor poor-gas producer is, we believe, quite a new step in the application of poor gas to power production. In previously existing gas producers the gas is made by blowing air, with or without water vapour, through incandescent carbon, and the product is mainly carbonic oxide, with more or less hydrogen, and a large admixture of atmospheric nitrogen, whence the appellation poor-gas, or the "gaz-pauvre" of the French, who appear to have given this name to what we call producer gas.

The gas, as made, is stored in a receptacle of more or less capacity, and passed thence to the engine. Obviously some moving power is necessary to force the air through the fuel. A fan is a usual instrument for this purpose. In the Taylor system, which can be seen in operation at the works of Messrs. W. C. Horne & Sons, Torrens Street, City Road, E.C., there is no gas holder, and there is no special means of propulsion of the air. There is simply an ordinary Otto-cycle gas engine, a water scrubber or cooler, and a cylindrical gas producer. From the producer are two upper outlets for gas. One of these leads to the engine, the other through a plug tap leads to the chimney. The fire is lighted in the producer, and the chimney serves to draw the products away until a sufficient incandescence has been established. This effected, the chimney is shut off by the plug cock, the engine is started and draws in gas from the producer, and continues to run and to draw its own gas. Thus the engine is made the means of drawing air into the producer, and the gas is used as made, without the expense of a holder. The whole gas-producing plant of a 15-B.H.P. gas engine is less than one-third the bulk of the cooling tanks necessary with all engines.

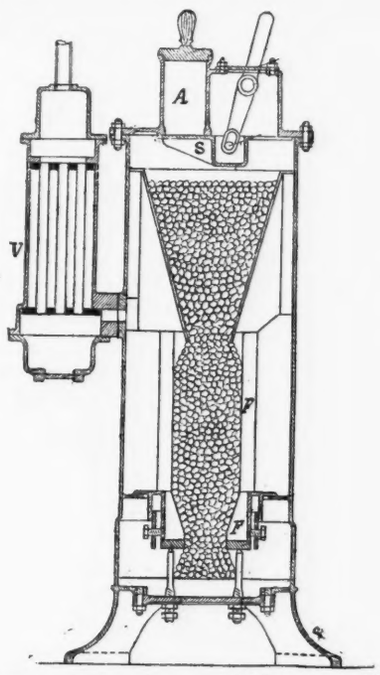
To assist in first lighting the producer, a small hand blower may be used. The producer is of tall hopper type, and is fed with



A, producer; B, vaporiser; C, charging valve; D, door; E, window; F, poker hole; G, scrubber; H, reservoir; I, air inlet; J, escape to chimney; K, gas outlet; L, delivery pipe; M, damper; N, air and vapour inlet.

Complete Producer Plant.

anthracite put in at the top through an air-lock. The consumption of anthracite per brake horse-power-hour is from 17 ounces for powers of 60 H.P to 25 ounces for small powers of 4 H.P. The gas as produced passes through a vessel of water and gives off heat to the latter; the resulting vapour passes into the producer, and is split up into its constituent gases, the oxygen going to form carbonic oxide with the fuel, and the hydrogen being set free to enrich the final product. The producer is, of course, lined with firebrick. Anthracite is so nearly pure carbon that very little ash remains to be removed. Coke, of course, may be used, but would require a larger producer for equal powers. The whole apparatus



A, charging air-lock; S, valve; F, firebrick lining; V, vaporiser,

Section of Producer.

can be placed in a very small place. It is worked by the engine itself and is therefore below atmospheric pressure internally, and is thus free from leakage or the risk of it. This is a matter of great importance, and conduces both to safety from fire and from the dangers of gas poisoning. The whole apparatus and process are exceedingly simple, and, we consider, will come into very large use in the case of small and moderate powers, such as abound in all cities. For printing offices and small factories generally, the system is excellent, and it should prove invaluable for country houses in electric light generation, in village communities for light and water supply, and generally for all power purposes in large public institutions. Already several hundred producers have been set to work in France to supply gas to engines of both English and French make. Indeed, one of the merits claimed for the system is that any ordinary gas engine can be used. There is no necessity for any special engine or any variant from the ordinary form. An engine already at work can be run up to the last while installing the new gas producer, and then in an hour or two coupled up to the new plant and run on producer gas.

CORRESPONDENCE.

Testing of Electro-Motors.

I must protest against some of the advice given in the article in the current number of your paper on the "Testing of Electro-Motors," by Mr. P. T. White.

One of the rules which we are always trying to impress upon our students is: *Never, on any account, to energise, and then suddenly break the shunt circuit of a motor without very special precautions.*"

Yet Mr. White, in his article, in order to test the field connections, advises the disconnection of the armature from the circuit, and the connection of the field to the mains through the starting switch, and then the releasing of the switch lever, so that, as he himself says, "A flash will result, due to the breaking of the shunt circuit."

I have known of serious damage done to more than one electro-motor by the use of this method.

Does Mr. White forget that not only will there be a large electromotive force of self-induction induced in the windings of the field itself, but also, in the case of motors with laminated fields, though the armature is disconnected from the circuit, and even though the brushes may be raised, the armature still lies in the magnetic field with a *closed winding?* Thus there is risk to the armature also by such a method of testing the field.

On page 9, Mr. White advises first the breaking of the shunt by the starting switch, and then says "the starter is *not* by any means intended to be a shunt breaker."

May I also suggest that there are occasions when a rapid approximate test for the efficiency of a shunt motor is required in places where it is not possible to load the motor artificially? It is for cases such as these that the method of which he complains is obviously intended, and very good results are obtained by it. I do not wish to defend the writing of the article in the ELECTRICAL REVIEW of November 8th, for the confusion of terms in it was hopeless, but only to defend the method therein suggested for a quick approximate calculation.

Let me also remind Mr. White that the statement made in hint No. 7, p. 9, is absolutely false; since with all shunt motors the efficiency increases with load up to a certain maximum, which will be usually found at or near full load.

It is mis-statements and wrong methods, such as those pointed out above, which make it difficult for the technical lecturer to get students to follow carefully the suggestions and rules he gives in lectures. "*For*," say the students, "*an article I read lately said this care was not necessary.*"

Wm. Cramp,
Lecturer in Electrical Design.

Central Technical College, S.W.,
January 9th, 1902.

The Tramway Junction at Sheffield.

It is always with diffidence that I enter the arena of newspaper correspondence, but having read a letter signed "Electric" in your issue, January 3rd, permit me to make a few comments on same as a practical tramway engineer with over 11 years' experience in the construction and maintenance of electric tramways (but I hope "Electric" will not include me as one of his "We engineers").

We are all supposed to have heard of Post Office corner, Sheffield; well, I have seen it, *both* as at present constructed, and as it was prior to the alterations; is it to be understood that the design is that of the manufacturers, or of the Sheffield engineer? All who have seen the present work will admit that the design and general construction is superior to the first junction, but that does not lead us to believe that the one set of material is superior to the other. I hold that this has been more a question of engineering than material; anyone who saw the first junction as then constructed, would look for bad results, at least those would who had had *real experience* with electric tramways; neither good nor bad castings will assist cars to keep metals if the construction of the line is defective, I mean by elevation or gauge, and the elevation of the Sheffield Post Office corner was faulty, and this is admitted.

Allow me to inform "Electric" there is nothing unique in the construction of that piece of work, and I have, along with many *engineers*, put in position and had working satisfactorily for years many pieces of tramway trackwork far superior to the junction in question, so that this may be information for "Electric," seeing that he has not seen any of them.

Sheffield was quite justified in having placed an order with a new maker of tramway material so that the results may be tested, but there is nothing "bold" in their action, and their "wisdom" will be justified by the results or otherwise.

With regard to our American brethren, many besides "Electric" have had the pleasure of meeting them, and have been pleased to discuss matters with them; but does "Electric" infer that *they only* possess the technical abilities to discuss tramway engineering? Surely your correspondent was not aware of the utter ignorance he was showing of his knowledge of tramways, their engineers, and their abilities. One would be very blind if one could not see that a brief was being held for one firm of manufacturers, which I do not hold, as I have now in use both English and American material; but this I do maintain, that be the maker who he may, if the tracks are faultily constructed, bad results must follow, but "Electric" may rest assured that our English engineers are as much alive to that fact as any American, and our manufacturers the same.

In conclusion, I would suggest that "Electric" should get some *practical* experience as a *tramway* engineer, when he will be better able to judge, and not condemn all ideas but his own as absurd.

Permanent Way Engineer.

Drop-forgings.

We noticed in your issue of December 20th a question as to the process of drop-forging, and have pleasure in giving you a short description for the benefit of your readers. The art of forging with drop hammers, which must be considered as "machine blacksmithing," was originally introduced by Colonel Colt, who adopted these machines for making parts of firearms. They have since been greatly improved, and the products of the drop-forging industry are now used in a great variety of mechanical arts.

Drop-forgings are made in dies, which are in two parts. One part is fastened in the hammer itself, which moves vertically between two uprights or guides, and is raised by means of friction rolls running in opposite directions, with a maple board running between them and keyed into the hammer from the top. The hammer is controlled by the operator with his foot, leaving his hands at liberty to handle the forgings. The other die is keyed into the anvil or base of the hammer. The ram, or hammer, rises until released, when it falls instantly, striking with the upper die the heated bar of metal placed on the bottom die, and forcing it into impressions in both dies. By a series of such blows the complete article is formed.

In the electrical industry a large number of copper commutator bars of any shape are forged in this way, and we shall be glad to give your readers full information of our plant doing this class of work.

Thomas Bolton & Sons.

The Electrical Volunteers at the Front.

In your issue of November 1st last, I see a notice asking for recruits for the Active Service Detachment of the E.E.R.E., and setting forth various particulars as to pay, &c. Perhaps a few observations on these items by one now serving may be of interest to those who have enlisted. First, a sapper will not save much money during his service; a man with a superior rating will get, roughly, £4 per month, but his engineer pay is likely to be considerably reduced for a month or two for the very slightest "offence" (this word can be made to cover a good deal in military life), so that if he draws nothing he will not have a great deal to his credit. Second, men should draw their pay up to date whenever possible, or they may find themselves penniless; the money can always be sent home if desired. Third, never get your

"rag" out with an Officer or N.C.O.; for "using disrespectful language" may be treated as a serious crime, to say nothing of "threatening" language. Last, but most important, great care should be taken of uniform, &c. Here are a few extracts, bearing on this point, from a memo. recently issued to detachments out here by the O.C. E.E.R.E. :—

"It should be kept in mind that soldiers are not supplied with underclothing after the first issue except upon payment. . . . . One pair of boots yearly are allowed free of cost. . . . . One uniform suit each 12 months is all that a soldier gets according to regulations." Of course, we know that all troops out here can get an issue every six months if the clothing is worn out, and certified as such by the C.O., but a good many of the E.Es. have had to buy uniform, and some have had garments given to them by men of other corps to make good worn-out things. Still, the matter of clothing may not seriously trouble the new detachment, as I hear they will be attached to the Telegraph Batt., R.E., where they will find things done (more or less) according to regulations in force in South Africa.

I hope the new detachment will have as good a time as those serving out here, and can promise them a hearty welcome from the various detachments of E.Es. they will meet in the country.

E.E.R.E.

South Africa, *December 12th*, 1901.

Review of Munro & Jamieson's Pocket Book.

I had much pleasure in reading your able and critical review of January 3rd, 1902, of the 15th edition. It is very difficult to get sound and impartial advice on the many subjects treated of in the pocket book, as well as useful hints regarding the best method of keeping it up to the times.

My partner and I all the more appreciate the unusual trouble which you have gone to in this instance.

If you will permit me, I shall send you a few questions regarding your suggestions, and the other points where excision or revision is desirable, in the hope of still further benefiting those who consult this *vade mecum*.

You call the "wee bookie" a table book! Well, it has most assuredly grown considerably stouter since its first appearance in 1885; but then, the science and practice of electrical engineering in all its branches has advanced so rapidly that we hardly know what to retain or expunge, and put in as the freshest and most reliable data, unless you and others, who are in daily touch with its different sections, will be good enough to periodically prescribe the latest and best remedies for its threatening obesity, as well as stimulate its compilers.

Andrew Jamieson,
Consulting Engineer and Electrician.

16, Rosslyn Terrace, Kelvinside, Glasgow.
January 1st, 1902.

High Speed Electric Pumps.

We notice in your last issue an article under the above heading, which purports, we take it, to describe the various types and the methods of operating and controlling motor-driven feed pumps.

This being a subject into which we have gone very thoroughly, and in connection with which we have made many practical experiments, in order to determine the most efficient type, we were somewhat surprised to find that no mention was made of the method of controlling the output obtained by varying the stroke of the pump.

That this pump has very considerably the advantage over the ordinary resistance-controlled type, more especially at the light loads, is well shown by the curves we enclose, from which it will be seen that at quarter output the relative efficiencies are very different, the variable stroke type being three times higher than the other.

The curve of the variable stroke pump given is taken from a pump which has been in work nine months, when, of course, the valve seats are not in the best condition for high efficiency readings.

We may say that we are now making a standard line of these pumps to meet the various conditions required in central station usage, hydraulic supply and general duties involving variable output.

Mather & Platt, Limited.

January 14th, 1902.

We notice in an article in your issue of the 10th inst., a reference in the last paragraph to pumps driven *direct* by electric motors. The author is probably not aware that we make a speciality of pumps of this type. We enclose you a pamphlet of the patent "Hatfield" pump, in which you will find particulars of the boiler feeder on p. 4, and we shall be obliged if you will insert this letter in your next issue. The apparatus consists of an electric motor driving two pumps, each capable of delivering 60,000 lbs. of water per hour against a pressure of 130 lbs. per sq. in., the speed of the pumps being 400 revolutions per minute.

Merryweather & Sons, Limited.

London, *January 14th*, 1902.

[The Hatfield pump referred to consists of two three-throw ram pumps coupled to a motor with claw clutches, the whole being mounted on a cast-iron base. The set illustrated was supplied to the Bristol Electricity Works.—EDS. ELEC. REV.]

WIRELESS TELEGRAPHY v. SUBMARINE CABLES.

I.

ON December 16th the Minister of the Italian Navy, M. Morin, received from Mr. Marconi, from St. John's, Newfoundland, bearing the date of the 16th, the following telegram :—"I have succeeded in receiving at Newfoundland the signals transmitted directly from England by means of wireless telegraphy." M. Morin replied :—"I thank you for your courteous communication, and admire this marvellous result."

Of course, if the result has really been obtained, it is indeed marvellous. But we are somewhat doubtful. The fact that signals and not messages are mentioned as having been received leads us to suppose that the signals may have been of atmospheric origin, caused by flashes of lightning more or less distant, or even by sudden variations in the atmospheric electricity, and consequently in the electrostatic charges of the receiving antenna.

If, on the other hand, the result really has been obtained, which, as it is a question of communication over the water, is not impossible, there are interested people who will be only too ready to say that the submarine cable companies will have to look to their laurels, since, if together with the problem of distance, that of complete secrecy with regard to the messages can be solved, which, in our opinion, can only be done by syntonisation, wireless telegraphy has gained a position from which it might be able to compete with submarine cables. If, in short, the three great desiderata enumerated by Sir W. H. Preece in 1899, at the time of Marconi's experiments across the Channel, have been attained, viz., communication to any distance with the Guarini repeaters, secrecy with regard to the messages by means of syntonisation, or by the Guarini sheaths or plane surfaces, and rapid communication by means of multi-communication, what more remains to be desired?

According to the *Express* New York correspondent, the feature of Mr. Marconi's speech at the banquet given to him the other night was his assertion that his instruments are so attuned that messages from and to them are not capable of being intercepted.

Mr. Marconi himself seems thoroughly imbued with the belief that commercial wireless telegraphy across the Atlantic is more or less assured, judging from the following telegram through Reuter's agency from New York, dated 13th inst. :—

Signor Marconi is quoted by an afternoon paper as saying that the transmission by wireless telegraphy of commercial news across the Atlantic was merely a question of time, and that he believed it would be done in less than a year. The paper states that Signor

Marconi will now devote his efforts solely to the building and properly equipping of receiving stations. The first English station to be thoroughly equipped would be Poldhu, in Cornwall, and two stations, at Nova Scotia and Cape Cod, would be the first equipped on the American side. It is added that while Signor Marconi will devote considerable time to perfecting arrangements for the transmission of messages between England and the United States, he will not confine himself to arranging the sending of the messages between those two countries. He has many other plans, and expects to be extremely busy in England. He is expected to sail on Wednesday, but his departure may be postponed until Saturday.

Another telegram of the same date, from a New York correspondent of the *Times*, tells us that Mr. Marconi said in a conversation that it was not because he received an "S" signal from Cornwall that he was so sure of the success of his experiment, but because the letter was repeated a number of times and at different speeds, from two or three a minute up to 32 a minute, which had been arranged.

We would like to ask in this connection, whether the signals were not received on a very sensitive telephone receiver, and not on a telegraph instrument?

In our "Stocks and Shares" article last week, we stated that the telegraph trouble, begun by the Marconi scare, was being accentuated by the foolish haste with which investors were tumbling over one another in their eagerness to sacrifice their holdings at any price.

Now, is there any real justification for the extraordinary fear which seems to have taken possession of the shareholders of cable stock? To elicit whether there is any reason for this terror-stricken attitude, we have been at some pains to ascertain the opinions of those most competent to decide whether or not submarine telegraphy is likely to suffer commercially through the advent of the Marconi system, at all events for some time to come.

It must not be overlooked that one very grave reason for the "slump" in telegraph investments was caused by the injudicious and quite unnecessary action on the part of the Anglo-American Telegraph Company in threatening legal proceedings against Marconi in Newfoundland. This gave a fillip to the belief that wireless telegraphy was seriously threatening communication by cable, and invested the matter with an importance by no means warranted. Probably the Anglo-American Company is now regretting having made so inconsiderate a move, but we will let this pass.

But if the action of the Anglo Company was unwise, what can be said of that of Mr. Ward, vice-president of the Commercial Cable Company?

In a telegram sent on Sunday last, the New York correspondent of the *Daily Telegraph* states that wireless telegraphy and its effect on the future of ocean cables were discussed before the Committee on Commerce of the House of Representatives, at Washington, on the previous day, in the course of the session on the proposed Pacific cable. In reply to questions by the chairman, Mr. Hepburn, Mr. Ward, vice-president of the Pacific Commercial Cable Company, said wireless telegraphy presented a serious question for the cable companies to consider. He was by no means certain that the Pacific project would have been started had long-distance experiments without wires occurred earlier. If it was really true that Mr. Marconi had signalled across the Atlantic Ocean, Mr. Ward said, it would have a marked tendency to deter persons from investing money to construct more cables. He admitted that the effect of the experiments had already been to depress cable interests.

How infectious is the wireless telegraph contagion may be judged from the following telegram to the *Times* dated 8th inst. from the Copenhagen correspondent of that paper:—

"The reports of the results of Mr. Marconi's experiments in wireless telegraphy across the Atlantic have been received with the greatest interest here, particularly in view of the fact that the project of laying a cable to Iceland has been discussed for a long time. Some well-known Icelanders have now applied to Mr. Marconi requesting him to make a calculation as to the possibility and the cost of instituting wireless telegraphy between Iceland and Shetland *viâ* the Faröe Islands. Such a means of communication would be of great value for correspondence between Denmark's Arctic possessions, including Greenland, and for British and French ships fishing off the coast of Iceland. It would also be of advantage for meteorological purposes."

Lord Kelvin, whose name is not unfamiliar in submarine cable circles, tells us that, notwithstanding the splendid results already realised by Marconi, he believes the property of the submarine cable companies will not be in the slightest degree injured by the greatest success possible in wireless telegraphy.

Mr. George Draper, the secretary of the Eastern Telegraph Company, is instructed to inform us that, so far, the company has seen nothing in the wireless telegraph experiments that would lead to the conclusion that it can supersede or take the place of submarine telegraph signalling, and the company believes this to be the opinion held by those experts qualified to judge. The chairman of the company will refer to the position at the ordinary general meeting at the end of this month.

Mr. A. L. Dearlove, of Messrs. Clark, Forde and Taylor, in answer to a question as to whether the Marconi wireless telegraphy with its possible developments is likely to affect submarine cable working prejudicially from an £ s. d. point of view, is of opinion that it will not do so.

The normal increase of traffic both to the West and East, says Mr. Dearlove, would in a short time provide sufficient work for several Marconi stations, and he thinks there is as little reason for the decline in telegraph stocks as there was for the fall which occurred a few years ago in gas stocks on the advent of the electric light, and when the boom in the shares of the latter novelty was in full swing.

In other words, there is room for both systems.

The telegraphing public demands a rapid service, an accurate service, and a secret service; so far as Mr. Dearlove's knowledge of Marconi's achievements goes there is much yet to be done before wireless telegraphy can even pretend to be as efficient as the present system. Certainly, it should not now be looked upon as a serious competitor.

Within the last two years cables with a carrying capacity of 600 letters per minute have been laid across the Atlantic, without notable effect on the shares of the competing lines, but because Mr. Marconi has gathered in Newfoundland a few "dots" coming from across the water, the cable shareholders are rushing in to throw away their property!

Accept, says our correspondent, the arrival of the "dots," by all means, but let it be remembered that the working speed attainable by wireless telegraphy between stations even a short distance apart is exceedingly low compared with that on cables and landlines. Also that, until a more perfect syntony is obtained, or a method of directing and confining at will the paths of the Hertzian waves is discovered, the difficulty of multiplying the number of "wireless" stations in a given area would appear to be insuperable.

As a friend aptly puts it: "Had wireless telegraphy been first in the field, and the *wire* method of cable and landline but just invented, what a splendid innovation and improvement would the latter system be considered!"

Marconi's working speed to America has not yet been given. It may be assumed that 50 letters per minute is a maximum rate, or about one-tenth as rapid as the last direct Atlantic cable laid.

Mr. Charles Bright, F.R.S.E., the son of the late Sir Charles Bright, of submarine cable fame, does not think it at all likely that the submarine cable business will suffer from the possible competition of wireless telegraphy, as we now have it, for many years to come.

The Marconi apparatus, he thinks, is too delicate in its adjustments to be absolutely reliable for practical work on a commercial scale; and the speed at which this apparatus can be worked is absurdly low as compared with the speed attainable by machine transmission—the latter being only limited, in practice, by the type of core provided.

On the question of syntony, Mr. Bright doubts whether this invention is sufficiently reliable, at present, for strategic purposes on an extensive scale, and certainly it is not a practical means of telegraphy for dealing with many thousands of commercial messages. On the other hand, any of the various methods—and it is well to remember the work of Prof. Oliver Lodge and others—should have an immediate field for lightship and rock lighthouse telegraphy, where, for reasons already known, it is found impossible to maintain communication with the mainland by means of a cable.

In concluding this article we would point out that the only position we see for wireless telegraphy is as a feeder for ocean and land telegraphy, not as an opponent. The replacing of the guiding lines for the ether waves afforded

by the submarine cables, by a single guiding surface, the ocean, would, we fancy, be a backward step in very deed. Moreover, the fact that there is a retardation in cable circuits is a great safeguard against their disturbance from extraneous sources, so that precautions against such are necessary only at their termini. The disturbance to the wireless circuit open to all the mundane, and probably extra-mundane interference as well, would militate against any reliability in its use, and the ease with which messages so sent could be interfered with and obliterated by other accidental or wilfully sent waves would preclude its adoption.

The adoption of harmonic telegraphy for the separation of different circuits is all very well on paper, it has been proposed times without number for metallic guided circuits, but never with any commercial success; and the alteration of the capacity of the receiving circuit would vary so much with atmospheric conditions that syntony would be very difficult to maintain on wireless circuits.

Truth to tell, we do not believe anybody outside the cable world has the slightest conception of what any new system of telegraphy has to go through before it becomes a possible or dangerous competitor to those already in existence.

The records of at least one cable company show that a single wire has carried with absolute secrecy and accuracy, over 600 messages consisting of difficult code words, in one hour, over a length of 4,000 miles.

How does this compare with Mr. Marconi's 32 letters (S) per minute, if we take the average word as consisting of five letters!

But there is another Richmond in the field :—

"The New York *Sun* says that Tesla, the electrician, has almost perfected his trans-ocean system of wireless telegraphy, and that there will be an exciting race as to who will be first."

LEGAL.

The Castner-Kellner Litigation.

In the Court of Appeal on Tuesday, before Lords Justices Vaughan-Williams, Stirling and Cozens-Hardy, the case of the Commercial Development Company, Limited, *v.* Atkins & Applegarth, of Birmingham, came on for hearing on appeal of the defendants from an order of Mr. Justice Buckley restraining them from doing anything with reference to stopping or taking out of the list an appeal in the action of Atkins & Applegarth *v.* the Castner-Kellner Alkali Company, Limited, of Liverpool.

Mr. Bousfield, K.C., who appeared for the appellants, said the point to be decided was whether the Commercial Development Company were entitled to compel Atkins & Applegarth to pursue this appeal. Mr. Justice Buckley had decided that they were, and had granted an injunction restraining them from taking any steps to withdraw the appeal. Atkins & Applegarth had a patent dated Dec. 9th, 1890, in respect of which they on Dec. 5th, 1897, issued a writ against the Castner-Kellner Company for infringement. About that time an action was brought by the Castner-Kellner Company against the Commercial Development Company with respect to a patent owned by the Castner-Kellner Company, and between Atkins & Applegarth and the Commercial Development Company an agreement was entered into by which his clients undertook, in consideration of the payment of £1,000, to prosecute their own action against the Castner-Kellner Company to trial or settlement. The Commercial Company further undertook, in certain events, to pay another sum of £500, and, within two years, to form a company, to which should be transferred the patent of the Commercial Company and the patent of Atkins & Applegarth. The latter were to receive as consideration a sum of £18,000 in cash and shares. That agreement was followed by another one with the object of giving the Commercial Development Company the conduct of the action, and, with that view, to instruct the latter company's solicitors, and in consideration of that, the Commercial Company undertook to be responsible for the costs of the action. Then for over three years from the date that matter got no further. The Commercial Company were engaged with their own litigation with the Castner-Kellner Company, and they having got the conduct of the action by Atkins and Applegarth, allowed that action to go to sleep for two or three years.

Mr. Astbury, K.C., for the respondents, said there was an agreement that that action should be held over pending the decision of the other action, and his friend had no right to say that his clients had allowed the matter to go to sleep.

Mr. Bousfield said it was he who had the right to complain of his friend, but as a matter of actual fact, the Commercial Company having got the conduct of the action, the matter did not come up for trial until May 16th, 1901.

Lord Justice Williams: What was the result of the trial?

Mr. Bousfield said that the result was that the patent was declared to be invalid. The whole point in question between them was whether the Commercial Company had the right to compel Atkins & Applegarth to go on with the appeal. The appeal was not entered by Atkins & Applegarth, but by the solicitors, they assuming they had the right to act.

Lord Justice Williams: It was in effect an appeal by the plaintiffs.

Mr. Bousfield said that a month before the action came up for trial, Atkins & Applegarth, who, during the three years, had seen their patent slipping away from them, they being under an obligation not to pursue their patent in the meantime, and being debarred from any negotiations with reference to their patent, went to the Castner-Kellner Company and represented to them what the state of affairs was. They then told them that they were willing to sell to them whatever interest they had in their patent, subject to the existence of the agreement with the Commercial Development Company.

Lord Justice Williams said he was still burning to know in whose interests Mr. Bousfield really appeared.

Mr. Bousfield said he had endeavoured to make it quite plain. There was really no mystery about it. The Court would gather from what had been said that Atkins & Applegarth, had ceased to have any real interest in the matter.

Mr. Astbury said they had sold their interest twice over.

Mr. Bousfield said the special interest of Atkins & Applegarth was, that they did not want their names to appear on the record. They did not want this appeal to be tried in that Court, and then to go on to the House of Lords, and to incur a very heavy liability in the shape of costs. Their only interest was to see that they were not made liable for costs. They were anxious to be quit of the whole matter, and he should contend that his learned friend was not entitled to make them incur those costs. Of course, the Castner-Kellner Company, in what they had done, had effected a sort of insurance, as in the event of the action being lost, they would have a share in the patent, and £18,000 in cash and shares in the company to be formed.

Mr. Astbury said the offer had been made again and again to put in the Commercial Development Company as plaintiffs, but the fact was that Atkins & Applegarth wanted to get the appeal off the list so as to escape liability for past costs. Under the agreement they were bound to prosecute the appeal, but apart from that they had sold their patent to the Commercial Development Company, and therefore could not do what they were now seeking to do. There was a subsisting contract for the sale of the patent at a future date, and it was a fraud on the part of Atkins & Applegarth to attempt to get out of the contract of sale in order that they might sell to the opponents of the Commercial Development Company. This was in reality the appeal of the Castner-Keller Company, and not of Atkins & Applegarth at all.

Their Lordships were of opinion that the judgment of Mr Justice Buckley was quite right. Messrs. Atkins & Applegarth could not be allowed to defeat the contractural rights of the Commercial Development Corporation under the contract with themselves as they were attempting to by withdrawing the appeal.

The appeal was accordingly dismissed with costs, as was also the motion to strike out the appeal in the name of Atkins & Applegarth in the action against the Castner-Kellner Company.

Leask *v.* Crown Electrical Heating Syndicate.

In the City of London Court on Tuesday, before Judge Rentoul, K.C., M.P., an action was brought by Alexander R. Leask, consulting electrical engineer, 91, Minories, E.C., to recover the sum of £20 5s. for services rendered between April and September last year to the defendants, the Crown Electrical Heating Syndicate, Limited, 15, Bury Street, St. Mary Axe.

Mr. Holloway, plaintiff's counsel, said that his client was an inventor of an ingenious contrivance called an electrical heater. He took out a patent for it, and he transferred it to the defendant company. At the time of the transfer he was requested to render certain services to the company in starting their factory where they manufactured the apparatus in question. He had done so for them, and on January 11th last year, when a particular portion of the work terminated, he received a cheque for his services. In March he was paid 15 guineas, and when he sent in his account he told the defendants that for any future work he did for them, he would have to be paid at the rate of half-a-crown an hour, which was about half as much as he ought to receive, except for the fact that he was very much interested in the welfare of the company. The business of the company was managed by one Stewart, who was an accountant, and not able to solve scientific problems as they arose from time to time. Stewart requested the plaintiff to give assistance in the factory whenever requested to do so by the manageress, Mrs. Edgar, who was employed to look after the workgirls. On 108 days the plaintiff attended at the defendants' business premises, and he gave in all 160 hours, for which he now claimed to be paid. There were a great many matters which the plaintiff might have claimed for, but which he had not done. He was constantly consulted about the business, but that he had not charged for. When the plaintiff asked to be paid, the defendants wrote and said that his services were quite voluntary, and that he was never required to render them at all. The plaintiff, in his evidence, said that in manufacturing the electrical heaters, skilled supervision was required, and that he gave. There were a great many parts which required to be carefully fitted. When the company purchased his patents his payment took the form of shares only, as he was so satisfied with it. He had done all in his power to promote the prosperity of the company. It was not true to suggest that he had worked voluntarily, and he did not think they could expect him to work for nothing. A special alloy wire

was used for the heaters, and his secret process was employed in the manufacture of the wires. As many as 15 different kinds of wire had to be used. On one occasion, after he had given instructions for the manufacture of the wire by his secret process, the manufacturers informed him that somebody belonging to the company had asked them to alter the constituents, but it was found not to act. He charged them £1 1s. a day, and that they thought was too much, because of his connection with the company. They had offered another man £50 cash down if he could introduce such a wire to the company as was made by his secret process. At that time he sent the defendants a bill for £33, and he accepted £10 10s. rather than go to law.

Mrs. Edgar, manageress, said that the defendants' manager specifically told her that whenever she was in difficulty about any electrical matters, she was to get assistance from the plaintiff, and that she had done on several occasions. He had always assisted her whenever she had asked for help or guidance. The main switch was always turned on by the plaintiff night and morning.

Mr. Horace Marshall, the defendants' counsel, said the plaintiff was considerably interested in the success of the company, and one of the terms under which he sold his patents to the company was, that he should render certain services from time to time in getting over little difficulties which might arise. Whatever definite work the plaintiff was asked to perform, he was paid for. For the subject matter of his present claim, no instructions were ever given, and payment had only been asked for by the plaintiff because, in all probability, he was piqued or annoyed at not receiving some appointment at the hands of the defendant company. The defendants' manager said it was not true that he had ever asked the plaintiff to instruct the manageress in electrical matters in connection with the heater. There was really no difficulty in adjusting the matter.

The learned Judge said people often forgot what really took place, and he was satisfied that judgment ought to pass for the plaintiff for the sum claimed, with costs.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Jan. 15th, 1901.		Week ending Jan. 14th, 1902.	
Auckland	Value £32	Alexandria	Value £52
Bombay	511	Auckland	2,983
Calais	30	Bombay	130
Calcutta	355	Boulogne	60
Cape Town	412	Brisbane. Teleg. cable..	235,000
,, Teleg. mat. ..	226	Buenos Ayres. Teleph. cable	900
Colombo	73	Calcutta	765
Copenhagen. Teleg. wire ..	405	Cape Town	463
Durban	630	Christiania. Teleg. wire ..	61
,, Teleg. mat.	127	Colombo	157
East London	109	Durban	30
Gibraltar	589	East London	197
,, Teleg. cable.. ..	13,080	Fremantle	114
Gothenburg. Teleg. wire ..	28	Gibraltar. Teleg. mat.	88
Kure. Teleg. cable	1,514	Greymouth	307
Lisbon. Teleg. cable	9,720	Hong Kong..	118
Madeira. Teleg. cable ..	490,000	Lisbon	50
,, Teleg. mat. ..	305	Madras	380
Malaga	120	Melbourne	80
Melbourne. Teleg. wire ..	475	,, Teleg. wire ..	1,980
Monte Video. Teleg. mat. ..	150	Otago..	130
N. Atlantic. Teleg. cable ..	84,700	Perth..	415
Rio Janeiro..	13	Port Elizabeth	420
St. Vincent. Teleg. mat. ..	2,503	,, Teleg. mat. ..	3,200
Santos	490	,, Telephones ..	79
,, Teleg. mat.	320	Port Said	30
Shanghai. Old teleg. wire ..	100	Stockholm. Teleg. wire ..	43
Sydney	796	Sydney	40
,, Teleg. mat.	125	Tokio..	138
Yokohama	119	Townsville	53
		Wellington	180
		Yokohama	854
Total ..	£158,087	Total ..	£249,446

Foreign Goods Transhipped.

Genoa. Electl. goods.	Value £118	Calcutta. Elec. goods ..	Value £403
Perth. Electl. goods	473	Fremantle. Elec. lghtg. mchnry.	4,396
		New York. Elec. mat.	160
Total ..	£591	Total	..£4,959

Bankruptcy Proceedings.—A winding-up order having been made against Harry South & Co., Limited, electricians, of Garrick Street, and elsewhere, the statutory meetings of the creditors and shareholders were held last Tuesday at the Board of Trade Offices, Carey Street, Lincoln's Inn Fields. Mr. A. S. Cully, official receiver, reported that the company was promoted by Mr. Harry South and Mr. Max J. E. Tilney. It was incorporated on December 15th, 1899, with a nominal capital of £10,000 in £1 shares, and was formed to acquire and take over as a going concern, and to expand the business then carried on at 10 and 12, Garrick Street and elsewhere under the style of "Harry South," and, with a view thereto, to enter into and carry into effect with settled modifications, as might be agreed upon, an agreement made between the parties; also to carry on the business of electricians, &c., and for other purposes, as defined in the articles of association. The first directors were Mr. Harry South (the vendor), and Mr. Max J. Tilney, who were also constituted managing directors for not less than five years at a salary of £5 per week each. No further directors were appointed. The qualification of the directors was the holding of £1,000 in shares, and both gentlemen duly qualified. No prospectus was issued to the public. Prior to the formation of the company, Messrs. South and Tilney had entered into an agreement with the following objects:—

1. Mr. Tilney to register the company with a capital of £10,000, to acquire Mr. Harry South's business.
2. Messrs. Tilney and South to be first directors at a remuneration of £5 each weekly.
3. Each director to apply for £1,000 in shares, and Mr. Tilney to apply and pay for a further block of £2,000 shares.
4. Immediately after the registration of the company, Mr. South to sell to the company the goodwill, plant, patents, &c., of his business, and all pending contracts, &c.
5. The sale to be completed by January 1st, 1900, and the liabilities and profits to be apportioned to that date.
6. The consideration for the sale to be £4,000 payable as to £2,000 in cash, and £2,000 in fully-paid shares.
7. The contract for the sale to contain an agreement for the assignment of the lease of Garrick Street premises to the company at a rent of £2 10s. per week.
8. Mr. South to carry on business until the completion and the purchase by the company.
9. Reserve capital to be offered to the existing shareholders.
10. The preparation of the articles of association and other legal documents; and
11. On execution of the foregoing clauses, the sum of £250 to be paid to Mr. Harry South as a deposit.

The purchase agreement contained the following additional provisions, namely, that Mr. South, whilst acting as managing director of the company, was not to be directly or indirectly concerned in any other business of electrical engineering within 10 miles of Charing Cross, also that the company were to pay all costs of flotation. The cash consideration of £2,000 was duly paid, and the £2,000 shares were allotted. The funds to enable this to be done were derived from Mr. Tilney, who subscribed for 1,000 shares as a signatory, and paid 10s. per share on allotment, and applied for a further £2,000 shares, for which he paid in full, making a total cash payment of £2,500. Mr. South, as a signatory, also subscribed for £1,000 shares, and paid 10s. per share on allotment. The business acquired by the company had been carried on by Mr. South for many years previously, and it was thought that by converting it into a company, and the introduction of capital, the business could be expanded, and good profits earned; but according to a balance-sheet dated December 31st, 1900, there was, after writing off £137 8s. 10d. for depreciation, a loss of £98 11s. 11d. No further balance-sheet had been got out, but it was believed that the company had never been carried on at a profit. The two directors were apparently at variance, which fact had, during the greater part of the company's existence, operated detrimentally to the success of the business. With a view to combining under one roof the offices, showrooms, warehouses, &c., Messrs. South and Tilney obtained a lease of premises at 43, Rathbone Place, and sublet them to the company, who paid the rent. The company obtained contracts for the supply, delivery, and erection of all necessary cables and machinery at the Trago and Herods Foot Works of the Safety Explosives, Limited. That contract was nearly complete at the date of the winding-up order. £250 had been paid to the company, a further £450 was due, and when the work was complete, the balance to be paid would bring the total price to upwards of £1,100. The company also took over an arrangement to provide an electrical installation for the Grand Theatre, at Islington, and had since continued it, but that arrangement was terminable at a week's notice on either side. It had been carried on at a profit. The difference between the directors, and the failure of the company to comply with a creditor's demand for payment, had resulted in the winding-up order upon which these proceedings were based. The company's liabilities were estimated at about £1,900, and the assets were valued at sufficient to provide a surplus after payment of the debts. Mr. Hilton, of 7, Lothbury, was appointed to the post of liquidator, to wind up the company in the ordinary course.

A composition of 7s. 6d. in the £ is announced in *re* W. R. Beckton, electrical and general engineer, of Herne Hill and Holborn.

Dissolutions and Liquidations.—A meeting of the Yorkshire House-to-House Electricity Company, Limited, is to be held at 1, Bond Street, Leeds, on February 18th, to hear an account of the winding up from the liquidator, Mr. Grosvenor Talbot.

Messrs. G. W. Brown & A. E. Conrady (Alexander E. Conrady, manufacturers of instruments, and apparatus and machines of precision for scientific and technical purposes) have dissolved partnership. Mr. G. W. Brown will attend to debts.

Books Received.—"Annual Report of the Secretary for Mines and Water Supply, of Victoria, during the year 1900." Melbourne: By Authority; London: Offices of the Mining Representative of Victoria. 5s.

"The Slide Rule," by C. N. Pickworth. Manchester: Emmott and Co., Limited. 2s.

"The Model Engineer and Amateur Electrician," Vol. v., July—December, 1901. London: Dawbarn & Ward, Limited.

"Willing's Press Guide for 1902." London: James Willing, jun., Limited. 1s.

"Manual of Electrical Undertakings. Vol. vi, 1901—02." Compiled under the the direction of Emile Garcke. London: Manual of Electrical Undertakings, Limited. 12s. 6d. net.

"Lockwood's Builder's, Architect's, Contractor's and Engineer's Price Book for 1902." Edited by Francis T. W. Miller. London: Crosby, Lockwood & Son, 1902. 4s.

Calendars and Catalogues. — Messrs. Mavor and Coulson's calendar card, with monthly slips for 1902, shows a good picture of one of their 600-h.p. slow speed generating sets.

Messrs. Frederick Jones & Co., of Perrin Street, Kentish Town, N.W., have placed before us a pamphlet showing the manufacture, uses, and tests of their patent silicate cotton, or "slag wool," as a heat non-conductor for covering steam pipes, boilers, &c. The material is made up into wire netted sheets, pipe-covering strips, removable sheets with backing of galvanised iron, mattresses, indestructible strips for superheated surfaces, cloth (silicate cotton sewn on canvas). Messrs. Jones also supply a non-conducting cement consisting of fossil meal and other ingredients, with silicate cotton as the binding agent.

The Brush Electrical Engineering Company have issued several new lists. One of these gives prices of their "Brush" transformers for sub-stations where the switches and fuses are separated from the transformer. Another list is of their arc lamp transformers for single street arc lamps off high tension mains, single enclosed arc lamps, and single arc lamps off low-tension mains.

The Tudor Accumulator Company, Limited, of 16, Victoria Street, S.W., has brought out a new catalogue of stationary cells, detailing and pricing the many types thereof, which are now on the market, and also giving dimensional information. Some excellent illustrations show large Tudor batteries which have been installed in Southampton traction station, Glasgow Corporation sub-station, and the County of London Company's City Road station.

The Pollard Electrical Engineering Company, of Hyde, has issued a calendar with monthly sheets, each containing illustrations of their dynamos and motors, and steam-driven generating sets.

Messrs. King & Co., of Leith, have issued a wall calendar which is beautified by means of several neat little photographic process illustrations of their electric lighting, driving, and other machines.

Messrs. Dick, Kerr & Co., Limited, have sent us a copy of their No. 109 pamphlet, in which the well-known English Electric continuous current generators are described and fully illustrated.

Messrs. P. R. Jackson & Co. have issued a new price list of enclosed ventilated motors for all kinds of industrial purposes.

A price list of electrical appliances comes to hand from Messrs. Wallach Bros., of 57, Gracechurch Street, E.C. A variety of station measuring instruments, laboratory instruments, &c., are well and freely illustrated and prices are given.

The British Electric Transformer Manufacturing Company, Limited, has issued a handy pocket diary and note book for 1902. A £500 accident coupon is given in.

Directories, &c.—Universal Electrical Directory, 1902.—The 1902 edition (the twenty-first) of this useful electrical directory has just been issued from the Press. It is essentially a directory, and the names are arranged in the usual convenient alphabetical manner in each of the different sections. One new feature which we think will be appreciated by the many users of this book, is the inclusion under central stations headings of details of the system and pressure of supply at each town in the United Kingdom; but even more important, we think, are the details in the Colonial and general section relating to light, power, and traction undertakings in other parts of the British Empire. The price of the work is 10s., and it can be obtained at the ELECTRICAL REVIEW publishing office, 4, Ludgate Hill, E.C.

"The Local Government Annual and Official Directory" for 1902 (*Local Government Journal* Office, 2, Dorset Street, Fleet Street, E.C. 1s. 6d.), cannot fail to be a useful book to those who are interested in local undertakings and proceedings, and who have occasion from time to time to refer to lists of the leading councillors and municipal officials in the many districts which make up the London area. Provincial councils and officials are also detailed in this, the 11th edition of this serviceable publication.

"Lockwood's Builder's and Contractor's Price Book" for 1902 (Crosby, Lockwood & Son, 7, Stationers' Hall Court, E.C. 4s.), is a comprehensive handbook of the latest prices of every kind of material and labour in the building trades. The Phœnix Fire Office rules for electric light and power installations are reprinted, and there is an electric lighting section in which some general notes and prices are given of plant for installations, also lighting fittings, arc lamps, motors, batteries, wiring and cost thereof, electric bell fittings, &c.

"Willing's Press Guide" which is issued in a very handy form, is out for 1902 (J. Willing, jun., Limited, 125, Strand, W.C., 29th annual issue. 1s.). Details of all papers in the United Kingdom are arranged in a very concise way, so that the main points about any publication may be taken in at a glance.

E.L.B. in France.—In connection with the large celebrations on the occasion of M. Waldeck Rousseau's visit to St. Etienne on Sunday and the opening of the new prefecture buildings, the French representatives of Electric Lighting Boards, Limited, received from the Government the order for the electrical illuminations, the extent of the contract being £1,250, and including as many as 4,000 lamps. A further important contract has also been obtained from the Paris Illumination Company, no less than 30,000 ft. of flexible cable, 1,000 superficial feet of boards, and 15,000 lamps having to be provided.

The Fall in Copper and Cable Prices.—W. T. Henley's Telegraph Works Company is announcing that, in consequence of the fall in the price of electrolytic copper, an additional discount of 10 per cent. off the March, 1901, list of india-rubber wires is now being allowed.

Messrs. W. T. Glover & Co., Limited, are also circularising to a similar effect, with the further intimation that, for a fixed quantity of wires and cables for a given period, a special rebate is made according to quantity.

The Bahamas Exhibition.—This exhibition, to which reference was recently made in these columns, has been postponed for one month, and will be opened at the beginning of March. The reason for the delay is that certain firms found the time too short to prepare samples.

Football.—The annual match between the "Robertson" Lamp Makers and the General Electric Company Football Club took place on Saturday, the 11st inst., at Wormolt Farm. After a most exciting game, the Lamp Makers proved the winners by three goals to none.

For Sale.—The Newcastle-upon-Tyne Electric Supply Company is open to dispose of one 550-I.H.P. engine, and 300-KW. Mordey alternator. See our advertisement pages for details.

The Dewsbury E.L. Committee wants offers for two 100-KW. Crompton four-pole dynamos. See advertisement pages.

G.E.C. Staff Dinner.—The staff dinner and smoking concert of the Manchester branch of the General Electric Company (1900), Limited, took place on Saturday, the 11th inst., at the Mosley Hotel, Manchester, under the chairmanship of Mr. A. Eckstein, and was attended by a large number of the members of the London and Peel works staff, and friends of the firm. Several directors of the company, including Messrs. H. Hirst, M. Railing, and H. Bevis, were present; and the gathering, if not of such large proportions as that seen at the annual London dinner of the firm, exhibited all that social good-fellowship which forms one of the principal characteristics of the gatherings of this company's staff. The after-dinner toasts included "The King," proposed by the chairman; "The Directors of the Company," proposed by Mr. R. Butterworth, and responded to by Mr. Hirst, and Mr. Eckstein; "The Peel Works Staff and the Visitors," proposed by Mr. F. Sells, the manager of the Manchester branch, and responded to by Mr. Brooker in a very humorous speech. The smoking concert was then proceeded with on a stage very tastefully decorated with festooned glow lamps, and proved to be highly diverting and original.

Insulating Compound.—The National Telephone Company, Limited, have accepted the tender of Rowland Carr & Co., of 6 and 8, Lime Street Square, E.C., for the supply of insulating compound for the next six months.

The Municipal Electrical Association.—We have received a copy of the proceedings of this Association for the year 1901. It contains the following papers, which were read at last year's gathering at Glasgow, and the discussions thereon:—"Notes on Street Lighting," by Bailie W. Maclay; "Uninsulated Returns on a Tramway System," by J. H. Rider; "Equitable Allocation of Costs in Combined Lighting and Traction Stations," by W. H. Tittensor; "Braking Apparatus for Electric Cars," by A. L. C. Fell; "Refuse Destructors in Combination with Electric Power Stations," by J. S. Highfield; "Coal and Ash Conveying Gear," by R. A. Chattock. The presidential address of Mr. Chamen is, of course, reprinted. There is a good deal of business matter relating to the M.E.A., and a comparative table showing the periods allowed for repayment and for construction of water, gas, electricity, and tramway undertakings in a score of towns.

New Boiler Works.—Last week a start was made in the boiler department of the large works of Messrs. Robt. Stephenson & Co., Limited, Darlington, which have been in course of erection for more than a year past.

Smoke Nuisance.—The Blackburn Corporation have been summoned for causing black smoke nuisance at the electricity works. The case stands adjoined for two months, during which the Nuisance Department will take regular weekly observations.

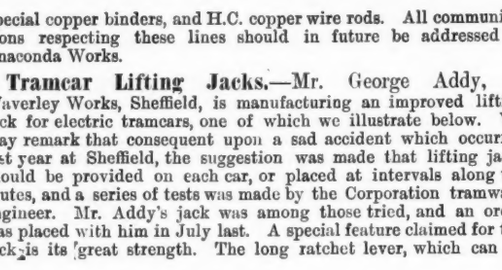
The Summons against the Charing Cross Company.—At Guildhall on 13th inst., Mr. Alderman Crosby had before him again the summons against the Charing Cross and Strand Electricity Supply Corporation, Limited, taken out at the instance of Mr. Edmund Woodthorpe, district surveyor for the northern division of the City of London, for beginning certain works without having served a notice upon him. The Alderman, in giving his decision, said the work was a street box for the purpose of inspection in connection with electric energy, and he found that the company had not given notice in accordance with Section 145 of the Building Act. He held that this was a building, structure, or work within the meaning of that Act. He convicted the company, and imposed a fine of 40s. and two guineas costs. A special case was asked for, and seven days were allowed for the company to make application in writing.

Table Decoration.—Mr. J. E. Austin, of Upper Baker Street, W., has sent us a print of a new table centre which he has designed and supplied. It has altogether about 200 small electric lamps intermixed with flowers, and when illuminated we should think it would be very effective.

Trade Announcements.—Messrs. Frederick Smith and Co., Wire Manufacturers, Limited, announce that they have now entirely discontinued the manufacture of copper wire at Caledonian Works, Halifax, the whole of this department being transferred to Anaconda Works, Salford, Manchester, which are now fully equipped with high-class machinery of the most modern type for the production of H.C. copper wire (plain and tinned), hard-drawn copper trolley wire, hard-drawn H.C. copper line wire, copper tapes and strips,

special copper binders, and H.C. copper wire rods. All communications respecting these lines should in future be addressed to Anaconda Works.

Tramcar Lifting Jacks.—Mr. George Addy, of Waverley Works, Sheffield, is manufacturing an improved lifting jack for electric tramcars, one of which we illustrate below. We may remark that consequent upon a sad accident which occurred last year at Sheffield, the suggestion was made that lifting jacks should be provided on each car, or placed at intervals along the routes, and a series of tests was made by the Corporation tramways engineer. Mr. Addy's jack was among those tried, and an order was placed with him in July last. A special feature claimed for the jack is its great strength. The long ratchet lever, which can be



fitted to either end of the jack, in connection with the combination of right and left-hand screw and toggle joint, supplies enormous lifting power. The movement is truly vertical; there is no side thrust. The steel baseplate is very substantial, being 8 in. wide and 20 in. long; total height over all only 6½ in. The weight of the jack is 96 lbs. There are no valves to go wrong; in fact, it is claimed that there is nothing to get out of order by rough usage. The Addy jack is also useful in sheds for "jacking-up" cars when changing brasses, &c.

What the British Consuls have to say.—*British v. German Trade with Chili:*—In a supplementary report on the trade of Chili for the year 1900, Sir Berry Cusack-Smith, his Majesty's Acting Chargé d'Affaires, remarks that the British Empire might profitably turn its attention to a table, published with the report, directing attention to certain articles of import in which the United Kingdom might have a larger share. The table contains a list of over 100 articles imported into Chili, of which, he thinks, the British proportion should be greater. Among those articles electric lighting and traction machinery is mentioned, the total import value being given as 1,217,000 pesos.—1 peso. = 1s. 6d. Of that total the British share is 123,900 pesos., against Germany's 1,046,000 pesos. Sir Berry Cusack-Smith points out, however, that much of the goods sold by German houses in Chili is of British manufacture, and he thinks there are still great possibilities for British commercial energy in Chili, if that energy be supported and directed by a thorough knowledge of the Spanish language, and a sympathetic study of the customs, wishes, and needs of the Chilian people.

Telephone Service of Grenada.—Mr. E. Drayton, reporting on the Blue Book of the Colony of Grenada for the year 1900, states that the revenue of the Telephone Department was £1,150, and its expenditure (including loan charges), £1,245. It had been contemplated, he remarks, to make, during the year, many changes in the working of the department, which had outgrown its original outfit, and as the trunk lines and exchanges had been working for 10 years, reconstruction was, in many places, requisite. The temporary removal of the manager to St. Vincent on special duty prevented anything being done, and towards the end of the year complaints were so numerous and insistent that the services of a special inspector were obtained by the Government for a report on the system. No tangible results, however, followed this report, and during the year 1901 the necessary improvements were commenced, and it was hoped that before the end of the year they would be effected.

Wing Propeller Fans.—Messrs. F. W. Potter & Co., of Phipp Street, E.C., have recently carried out some interesting tests on their Wing propeller fans, for which purpose special apparatus was fitted up at their works. The fans were driven by an electro-motor, and propelled the air through a tube 18 ft. long × 27 in. diameter, against a light screen suspended 18 in. from the open end of the tube. Other fans by well-known makers were also tested, and it was found that to produce the same pressure on the suspended screen, the Wing fan took less than half the power required by one, and less than two-thirds of the power taken by another of the rival fans. As the losses in the motor, which was of an inefficient type, were included in these results, the performance of the Wing fan must have been still better than would appear at first sight. The quantity of air delivered per minute corresponding to various pressures on the screen has been ascertained by Messrs. Potter & Co., from which it appears that 700 watts supplied to the motor delivered 7,200 cub. ft. with the 25 in. Wing fan, as compared with 5,250 cub. ft. by one of the rivals, while the same power moved 6,500 cub. ft. with a 24-in. Wing fan, as against 5,300 cub. ft. by a 24-in. fan of another make. Messrs. Potter & Co. have carried out numerous experiments on the best shape and angle for the blades of fans, and judging from the above results, their scientific methods have been rewarded by success.

ELECTRIC LIGHT AND POWER NOTES.

Brighton.—The Electricity Committee recently reported that they had considered the question of Mr. Fowler's appointment, and it was resolved that he be informed that at the expiration of the term of his engagement with the Corporation, viz, March 2nd, 1902, his services would not be required in his present position; it was also resolved that in the event of Mr. Fowler obtaining another appointment before March 2nd next, the Corporation would release him from his engagement. A lengthy discussion ensued on these proceedings with reference to the Committee's decision not to retain Mr. Fowler as assistant manager of the electricity undertaking. The chairman stated it was a question of expediency. Councillor Carden moved the exception of the resolution, remarking that if it were carried the Corporation would be guilty of a great act of injustice, as Mr. Fowler had volunteered for service at the front in 1899, on the understanding that his berth should be kept open; he had now returned, and it would be very unfair, and unpatriotic on the part of the Council, to discharge him. He was a valuable servant, and had been in the employ of the Council for 10 years. The Committee's recommendations were thrown out, and the Council thus saved from a dishonourable action. It having been found necessary to obtain expert advice, on account of the sandy nature of the ground, the Committee recommended that Mr. W. R. Galbraith be engaged as consulting engineer in connection with the electric power station now in progress at Southwick, under Messrs. Pedrette and Co.'s contract, at the inclusive fees of 3½ per cent. on the £25,000 (£875), the Corporation to pay in addition the wages of an inspector (about £3 per week), to be recommended by Mr. Galbraith.

Bristol.—At a recent meeting of the Electrical Committee, it was reported that 1,758 customers had applied for current, of whom 1,688 had been connected with the supply. The applications amounted to 126,584 lamps (reduced to 8 C.P.), of which 119,689 had been connected. Motors to the amount of 744 B.H.P. had been applied for, of which 680 H.P. had been installed.

Chesham.—The D.C. has resolved to obtain expert advice on the question of electric lighting, a company having offered to purchase the Council's prov. order and instal the plant.

Claremont (Cape Colony).—The Local Council lately considered a proposal to purchase the E.L. Company's plant, &c. It was, however, considered that the price asked was excessive, and a resolution was agreed to that the Government be asked to afford the Council expert advice on the whole question.

Crewe.—The use of electricity for machine driving is rapidly superseding other means of driving in the extensive workshops of the London and North-Western Railway at Crewe. The most recent applications of electrical power have been to a number of cranes in the works, and to the purpose of signalling. Some 20 miles of electric signalling have already been installed.

Derby.—The E.L. Committee has accepted a tender for 500 tons of coal at 8s. 6d. per ton.

Enfield.—The B. of T. is to be asked for a prov. order for electricity supply in Enfield by the North Metropolitan Electrical Power Distribution Company, who have already arranged terms with the Enfield D.C., and have, therefore, the support of that authority. The company have already got to work in High Barnet, and more recently in Hertford, and it is part of their scheme that extensive generating plant will be laid down in a large building which it is proposed to erect near Ponder's End—a part of Enfield. Under the order the area of the supply will be Enfield. It has been agreed by the company that, within a period of two years after the commencement of the order, they will lay down distributing mains for the purposes of a general supply in the principal roads. The company will be entitled to charge, per quarter, if the quantity of energy does not exceed 20 units, 11s. 8d.; if the quantity consumed exceeds 20 units, for 100 hours at the maximum demand in such quarter at the rate of 7d. per unit; and after 100 hours at the rate of 2d. per unit. The D.C. may, at the expiry of 14, 21 or 28 years from the commencement of the order, require the company to sell to it the undertaking for the fair market value; and after the expiration of 35 years the Council shall be entitled to purchase upon the terms specified in the Electric Lighting Act, 1888.

Finchley.—The D.C. has taken temporary offices for the electrical engineer, Mr. Calvert, who has been empowered to engage the services of a competent draughtsman.

A meeting of ratepayers and owners was held on the 6th inst. to consider the Bill which has been presented to Parliament for electric lighting and road widenings, in connection with the Middlesex C.C. Light Railway Scheme. The resolution in favour of the Bill was lost by an overwhelming majority. The chairman demanded a poll of the parish, on behalf of the Council.

Halifax.—The Corporation are threatening proceedings against the Electric Construction Company for breach of contract. At the monthly meeting of the Town Council held on Wednesday last week, the following resolution was agreed to:—"That the town clerk be instructed to claim the sum of £500 from the Electric Construction Company, Limited, in consequence of the non-fulfilment of their contract by the delay in the delivery of engines and generators supplied by them to the Corporation." There was some divergence of opinion with respect to the amount of the claim; some members thought the amount ought to be at least £1,500.

The T.C. has decided in future to charge all consumers of e ectricity for a minimum quarterly consumption of 20 units.

Inverness.—Mr. W. P. Adams delivered an address in the Town Hall recently on municipal electric lighting. Messrs. Crompton & Co. have offered £1,000 for the prov. order and a rental, the town having the option of purchase at intervals; the lecturer expressed his opinion that the Council would want to buy out the company at the first opportunity.

The T.C. is making inquiries as to the possibility of obtaining water power from the Caledonian Canal.

Kimberley.—Last month Councillor Henderson brought forward the necessity there was for extensions being carried out as early as possible for the cables and plant for the municipal electric light supply. A special committee was formed for the purpose of dealing with this matter in its various forms, such as extent, localities for new cables and means of financing the scheme. The electrician, Mr. C. G. Vines, reported that the output was showing a great improvement after a year's running; as a comparison, the return for November, 1900, showed 4,520 units, while that for November, 1901, was 12,245 units, which was very good for a summer month.

Large Engines.—We understand that Messrs. Davey, Paxman & Co., of Colchester, the well-known engineers, have put down a large additional plant in their works, and that they are now quite prepared to make electric light engines up to 3,000 H.P., guaranteeing at the same time their efficiency, durability, and steam consumption.

Leigh.—The Electricity Committee has received tenders for condenser, cooling tower, pumps, steam and feed pipes, &c., at the works. These were deferred, the engineer being instructed to obtain tenders for the steam and feed-water pipes, valves, injectors, &c., which will be required to connect the boiler and economiser with the existing mains.

Limerick.—On Monday the first sod was turned in connection with the electric lighting of Limerick City. The scheme will cost altogether about £22,000, £16,000 of which will be for electric plant, and the remainder for building a power station. Mr. Dillon, of Limerick, is the contractor for the plant, which will be supplied by the Electrical Company, London. The entire contract has been arranged under the plans of Mr. Enright, of London.

Lincoln.—The City Council, acting through the Electricity Works Committee, has purchased a number of motors to let out on hire to customers. An electric balancer is to be acquired at an estimated cost of £350.

Liverpool.—On a recommendation of the Health Committee that the tender of Messrs. Pulford Bros. for installing the electric light into the sterilised milk depôt be accepted, Mr. H. Miles said the Corporation had a committee quite capable to do such work. It was a surprise to him that the Health Committee had passed over another committee of the Corporation in giving out the work.

Alderman Menlove said they asked for tenders from three different concerns, including the Electric Lighting Committee. The tender from the Committee was the highest received, and the lowest was that of Messrs. Pulford Bros.

Mr. R. Dart thought it would be better policy for the Health Committee to give the work to the Corporation. He considered the work should be given unconditionally to the Electric Lighting Committee.

Alderman Watts said it would be unwise to place the Electric Lighting Committee in a position of preference. He was glad to see that the outside public could compete with them, and take a contract from them.

The recommendation was agreed to.

If there ever was a doubt as to a municipality competing with its own ratepayers, surely this must put an end to it.

London.—CITY. The City of London Electric Lighting Company is pressing its request that the Corporation will decide, without delay, whether it desires the company to continue the lighting of the main thoroughfares in the central and western districts, in respect of which the Court of Appeal has decided that no agreements between the company and the Corporation exist.

MARYLEBONE.—The Borough Council has approved of the L.C.C. Electric Light Bill, and of the principle of the Bill proposed to be introduced by the Board of Trade for the alteration and re-adjustment of electric lighting areas in London.

POPLAR.—The Borough Council has adopted the report of the Electricity Committee, which fixes the charges at 5d. per unit for the first hour's supply per day, and 3d. per unit after, and 1½d. per unit for power purposes.

Long Eaton.—The U.D.C. having made application to borrow £15,000 for electric light works, the L.G.B. has intimated that an inquiry will be held in due course.

Lynn.—The Board of Guardians have decided to adopt electric lighting at the workhouse and infirmary, and to obtain current from the Corporation service.

Manchester.—It has been officially stated that the work of the Electricity Department has made such progress that the Committee has decided to give notice that applications for the supply of electricity for motors can now be considered. The Committee is also prepared to consider applications for the supply of power to motors.

Market Drayton.—The R.D.C. has received a letter from the Market Drayton Electric Light and Power Company, stating that it is the intention of the company to apply to the B. of T. for a license to supply electricity in the parish of Drayton-in-Hales.

Melbourne.—An important decision affecting the right of the Municipal Council to differentiate in the charges for electricity for motive power and for lighting purposes was given last month by the Full Court. The action was originally brought by the Attorney-General on the relation of the Metropolitan Gas Company against the Municipal Council of Melbourne, and the Chief Justice found in favour of the municipality. On the appeal by the gas company the question was recently argued at length before the Full Court, which was divided upon the subject, the majority holding that the Chief Justice was wrong in his views, and giving judgment that the meaning of Section 39 of the Electric Lighting Act, taken by itself, was that there should be a uniform charge for electricity, no matter for what purpose it was required, in what quantity it was supplied, or during what time, whether by day or night. The section provided that there should be only one charge made to all persons who were supplied with electricity.

Newark.—The E.L. Committee has recommended the Council to decline the proposals of the Derbyshire and Notts. Electric Power Company and to proceed with its own undertaking. The company had offered a supply of electricity in bulk at 1½d. per unit, plus 10 per cent., for a guaranteed minimum quantity of 250,000 units for a term of five years.

Nottingham.—The buildings for the new electricity works of the Corporation on St. Ann's Well Road are now completed, and ready for the plant to be installed.

Penzance.—The T.C. has taken up a favourable attitude towards the Cornwall Electric Power Bill.

Prestwich.—The U.D.C. having considered a report of a sub-committee on the supply of electrical energy by the Manchester Corporation, has requested this body to at once return the draft agreement now in its possession, without prejudice to future negotiations.

Romsey.—The Mayor presided at a meeting of owners and ratepayers held last week to consider the electric lighting of the town. Mr. Cownie, secretary of the National Electric Wiring Company, said that for some time the formation of a company in Romsey had been contemplated. They thought that a capital of £7,000 would do, and his company would be prepared to find half the amount, £3,500, and would require the other half to be guaranteed. The company felt so sure that the venture would pay, that they would guarantee the payment of 4 per cent. from the beginning.—Mr. Mitchell, the company's engineer, said it was proposed to get the power from Mond gas, which was very cheap. The Mayor proposed a resolution approving of the scheme, but it was defeated by a large majority.

St. Helens.—A deputation from the Corporation has interviewed Mr. Gerald Balfour, President of the Board of Trade, with respect to the Board's refusal to sanction a supply of electricity by the overhead system, at a pressure of 500 volts, to works at St. Helens, on the ground that such supply could be given by underground mains. The President of the B. of T. promised to consider the facts laid before him by the deputation.

Much progress in the use of electricity is reported. In 1898, 35,758 units were sold to private customers; in 1901 the number was 260,404. The number of lamps connected has increased from 4,550 in 1898 to 21,229. As regards energy used for traction, in 1900 the Tramways Company used 182,076 units; last year they were supplied with 599,042 units. Eighteen miles of track are now in use, all of which are being worked electrically.

Sheffield.—The T.C. is considering the advisability of establishing a municipal insurance fund. The premiums at present amount to between £2,000 and £3,000 a year.

South Wales.—The South Wales Power Distribution Company are going to work in earnest; their staff has been increased, and Mr. E. L. Hill has been appointed resident manager. The managing director of the company, Mr. G. L. Addenbrooke, is also devoting himself to important negotiations which are now taking place between the company and local authorities, and proprietors of large works, for the supply of energy, both for power and lighting.

Southampton.—At the last meeting of the T.C. it was reported that Mr. Street, the newly appointed electrical engineer, had entered upon his duties. In connection with the accounts, attention was called to a payment of £873 4s. 3d. to the consulting engineer, and the chairman of the Committee gave an assurance that, as Mr. Street would be able to cope with all the work without outside assistance, such an item would not appear again.

Southport.—The Electricity Committee has resolved that an order be placed with the British Insulated Wire Company for the supply of cables during the next two years; also that application be made to the L.G.B. for power to borrow £32,000 for extensions to the electricity plant, mains, &c. In view of the fact that radiators are mostly used during the winter months, when the ordinary demand is at its maximum, it is not considered advisable to further reduce the price for energy consumed for heating purposes.

The number of consumers at the end of 1901 was 910, with 56,780 lamps, and the output, including energy for traction, was 1,023,970 units. Of this, private supply accounted for 731,777 units, at an average price of 4·05d.; public lighting, 98,739 units, at 1·34d.; traction, 193,454 units, at 1·74d., the average price for all classes of supply being 3·35d.

Spain.—Plant is about to be put down to utilise the water-power of the River Franchuena (in the province of Viscaiga) in the generation of electrical energy for lighting and power purposes, the necessary concession having just been granted.

Stafford.—The electricity department of the Corporation being now in a position to meet demands for the supply of the illuminant outside the borough, application is to be made to the B. of T. for a license to supply electricity to the surrounding districts. Subsequently a provisional order will be applied for.

Stockton.—A L.G.B. inquiry was held by Mr. R. H. Bicknell, M.I.C.E., last week, into the application of the Corporation for leave to borrow £27,500 for electric lighting purposes; £6,500 of this was for excess expenditure over previous loans, and the remainder for new work.

Uitenhage (Cape Colony).—The T.C. lately invited an electrical expert to visit the town and furnish a specification (with estimate of cost) for the installation of electric lighting of the streets, from a certain available water supply.

Weybridge.—Mr. H. Watts, local engineer for the Urban Electric Supply Company, states that energy can be supplied in a few months' time on the following terms:—Lighting, 7d. and 4d.; power, 4d. and 1½d.; slot meters, 6d. per unit (including hire). The company will wire premises at a charge of 4½d. per lamp per quarter, with option to purchase at any time.

Worksop.—Last week Colonel Hepper, R.E., inspector to the L.G.B., held an inquiry in respect of the application of the U.D.C. for permission to borrow £8,500 for the extension of the electric lighting plant. The consulting engineer (Mr. A. B. Mountain, of Huddersfield) said the present plant was capable of supplying 6,000 lights, and it was not safe to face the next year without addition, as they were nearly up to the maximum. The works had only been running three months.

The Traders' Association has decided to memorialise the U.D.C. to reduce the price now charged for electricity. It is felt by the members of the association that 6d. per unit is much too high.

Worthing.—The lowest tender for building the generating station was £6,870; the surveyor was of opinion that it could be done for less, and the Corporation decided to do the work itself under his supervision. It was reported to Tuesday's Council meeting that the actual cost of the station has worked out at £5,100, and the Council, in recognition of the satisfactory result, agreed to vote the surveyor 100 guineas. The consulting engineers have been asked to report as to the extensions of the undertaking, which in their opinion will be needed in the near future. Difficulties have arisen in disposing of the water used for condensing purposes, and the Council has accepted a scheme to overcome the trouble, prepared by the consulting engineers and the borough surveyor, which will involve an expenditure of £2,600.

Margam.—An interview has taken place between the E.L. Committee of the D.C. and representatives of the South Wales Electrical Distribution Company. The terms submitted for the company conditioned a minimum bulk supply of 50,000 units at 2·90d. per unit. Any greater quantity would be supplied at a proportionate reduction. It was pointed out that to make such favourable terms it was necessary that the company should be able to make an agreement with each of the other local authorities, such as Neath, Briton Ferry and Aberavon.

ELECTRIC TRACTION NOTES.

Aberdeen.—The Tramways Committee recently received a letter from the M'Elroy-Grunow Electric Railway System asking for an extension of the time granted to them to complete the experiment with a section of the third-rail tramway system on the beach route. The Committee did not see their way to agree, and resolved to recommend that intimation should now be made to the M'Elroy-Grunow Electric Railway System that, in respect of their failure to equip the section within the time specified, the Council must consider the agreement as at an end. It was, at the same time, resolved to recommend that the company should be allowed facilities for continuing their experiments, if they desired to do so, on condition that the operations are so carried on as not to interfere with the use of the tramway or the working of the traffic.

Last week the Council decided that all existing lines not yet electrified, with the exception of the section from Queen's Cross *viâ* Rosemount to Union Bridge, be adapted for electric traction, and equipped on the span-wire system from side poles at an estimated cost of £34,446.

Aston.—The T.C. has resolved to join the Aston Tramways Company in an application to the B. of T. for the appointment of a referee to assess the value of the company's undertaking, and has decided to approve of the plans prepared by Mr. Wilson for the erection of a power station and the laying of cables for electric lighting and tramway purposes, at an estimated cost of £65,000, for which a loan will be obtained.

Birkenhead.—The Chairman of the Electrical Committee says that the trams are going the right way to earn a handsome profit by the end of March, after paying interest and sinking fund.

Brighton.—Two other routes, the New England Road and Beaconsfield Road sections, have been opened to the public, and the Board of Trade inspector is expected down shortly to examine the working of the patent brake which has been fitted by his recommendation to prevent the cars from running backwards down the hills. The cars will be tried on the steepest grades, and if everything is satisfactory the remaining routes will be at once opened. Up to the present about half a million passengers have been carried in about six weeks, and as only half the lines are open it looks well for the future success of the system.

Cairo to Mecca.—An *Evening News* telegram says that the United States Construction Company, of Cleveland (Ohio), has negotiated through Signor Spanler, of Rome, for concessions for electric tramway lines from Cairo to Mount Sinai, and along the Red Sea to Mecca. A branch to Damascus is also contemplated. The Sultan of Turkey has just granted the requisite concessions. The Cleveland company will finance the undertaking if it obtains the construction work. The promoters of the scheme believe that electric tramways will be hailed with delight by the millions of Mahommedans who make annual pilgrimages to Mecca. The towns surrounding Jerusalem are also said to offer good opportunities for short lines.

Chatham.—The Chatham Electric Tram Company will very shortly be busy in the neighbourhood of Chatham and New Brompton. The large generating station (which is situated at Luton) is fast approaching completion, the boilers being in, and the shaft almost finished. The tramlines are now down through Chatham, and on to Old and New Brompton, and the Dockyard and Garrison generally, including the Royal Marine Barracks, H.M. Gun Wharf, the Royal Engineers' Barracks, and the School of Military Engineering, Chatham Line Barracks, the new Royal Naval Barracks at St. Mary's Vale, and the Royal Naval Hospital at the top of New Brompton.

City to Wimbledon Railway.—The *Financial Times* gives the following details of the Bill to be shortly promoted for the purpose of incorporating a company with powers to construct an underground electric railway from the City to Wimbledon. The proposed line will commence near Cannon Street Station, and will pass under the Thames to Southwark, whence it will proceed *viâ* Lambeth and Wandsworth Road to Clapham Junction. From this district it will run *viâ* St. John's Hill to Wandsworth, and thence to its termination at Hartfield Road, Wimbledon. The railway will be constructed in two tunnels, with an internal diameter of 12 ft. 6 in., and similar in other respects to the existing tube railways. The generating station will be erected on lands on the boundary line between Wandsworth and Wimbledon and abutting on the Wimbledon and Fulham line of the London and South-Western Railway. The company seeks power to appropriate the subsoil under any building, premises or hereditaments without being required to purchase any such property or any easement or right to the use of the subsoils, provided that the crown of the tunnel does not come within 30 ft. of the lowest floor of any property affected by this clause. The total capital required for this scheme is £8,000,000, of which £6,000,000 will be raised as share capital and £2,000,000 by the creation of debenture stock. The first directors are to be Mr. Ernest Schenk, Mr. Thomas A. Meates, Mr. George Riley, Mr. Herman Gwinner and another. The period required within which to complete the railway is five years. During that period interest will be paid out of capital on the shares taken up, provided that not more than £600,000 is expended in this manner.

Darlaston.—The U.D.C. have approved the British Electric Company's designs for poles and feeder pillars which they propose erecting between Bull Stake, the Crescent, and the Green.

Derby and Nottingham.—Sir Bache Cunard, the principal shareholder of the company which contemplates establishing a system of light railways to connect Derby and Nottingham, and to open up the populous districts in the vicinity of Long Eaton and Stapleford, attended the monthly meeting of the Shardlon Rural District Council on Monday for the purpose of explaining the details of his scheme and soliciting the support of the Council therein. The Council resolved to remain neutral in regard to the matter.

East Molesey.—The U.D.C. surveyor has found that the L.U.T. Act of 1901 does not carry out all the agreements originally made by the company. The Council has therefore decided to oppose future Bills of the company.

(*Continued on page* 103.)

THE MANUFACTURES OF ROYCE, LIMITED.

The following illustrations show some examples of standard electrical machinery as manufactured by Messrs. Royce, Limited, of Manchester. Established in 1884, the firm has consistently grown, and in order to meet increasing requirements of supply, new branch works have been erected and are nearing completion in Trafford Park, Manchester, with ample facilities for extension. These works are being laid out in the most approved manner, and equipped with special labour-saving tools and devices in order that work of the heaviest kind may be undertaken.

The generator represented in fig. 1 is of the 12-pole low-speed type, arranged for driving direct by means of a turbine,

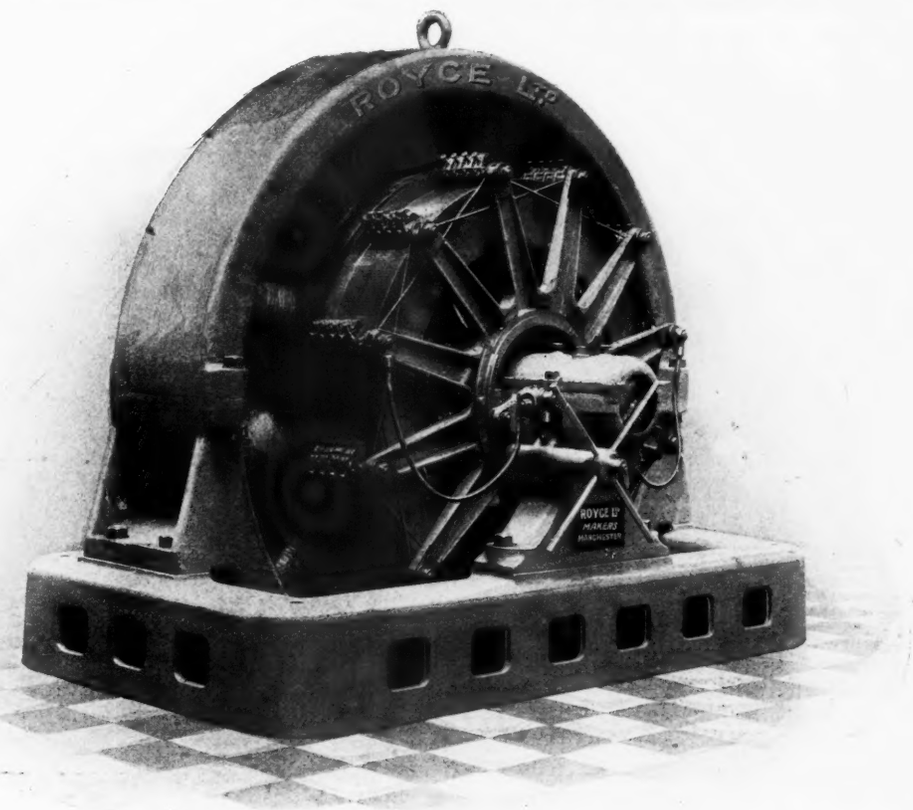


Fig. 1.

the rated output being 350 kw. at a pressure of 500 volts when running at a speed of 130 revolutions per minute.

A smaller machine is illustrated in fig. 2, arranged for driving by ropes. The output is 100 kw. at a pressure of 200 volts when running at 400 revolutions per minute. These machines represent the result of very careful study based upon wide experience during the years since slotted armature cores and multipolar fields for electrical machinery were generally placed upon the market.

The general design is characterised by a substantial yoke of circular form—provided with inwardly projecting pole-pieces of soft steel of very high magnetic permeability, the pole-pieces and field windings being so proportioned as to reduce the distortion due to armature reaction to the lowest possible limit. The field coils are wound upon bobbins made of sheet steel, with substantial brass flanges at each end. The shunt and series coils are separate, and are wound in separate compartments, the series coils being composed of drawn copper conductors of rectangular section wound on edge.

The armatures are of the slotted drum type, the core consisting of soft-steel discs, well annealed both before and after the slots are punched in their periphery. The discs are insulated from each other, and are held together by stout plates extended on their faces in order to carry the ends of the windings, and presenting a large radiating surface for the dissipation of heat. The core thus built up is firmly attached by keys to a substantial armature spider, an extension of which carries the commutator, so that any possibility of relative motion or vibration between the armature and commutator is completely eliminated; ventilating spaces through the spider and armature core are so arranged as to allow a constant circulation of air when the machine is running.

The armature winding consists of interchangeable copper bars bent into shape on jigs, and thoroughly insulated with a special composite insulation before being put into place on the armature core. Before assembling, the coils are thoroughly varnished and stoved, in order to expel all moisture and seal the surface effectively against the re-entering of damp.

The commutators are characterised by a large number of sections, and there is rarely more than one turn of armature winding to each section of the commutator. The segments of hard-drawn copper are insulated from each other and from the supporting hub by means of mica. The bars are held in position at each end by rings having a "V" section, and the whole is solidly drawn together by means of stout bolts.

The brush holders and mechanism have received careful attention; the carbon brushes are carried in holders of the radial parallel feed type, arranged to give an easy adjustable pressure on the commutator. The current density in the brushes when operating at full load is about 30 amperes per square inch. The brush holders are carried upon a cast-iron yoke of rigid construction, provided with a hand-wheel and screw, which accomplishes the adjustment of all the brushes simultaneously.

The mechanical construction of these generators has been fully thought out, and the bearings and various sections of metal are very ample for the loads which they have to carry. The machines will deliver their rated outputs continuously with a very moderate rise of temperature and without sparking. Sparkless commutation has been carefully studied, and the machines are rated to operate sparklessly with a fixed position of the brushes; they will carry an overload of 25 per cent. for one hour, and momentary overloads of at least 50 per cent. without injury or distress.

The makers have standardised two lines of multipolar generators, one series being suitable for lighting service, and another for traction and power work, the latter having field coils over-compounded, so that the potential at the terminals is 500 volts on open circuit, and 550 volts when the full load current is being supplied.

A standard semi-enclosed multipolar type motor, rated at 12 B.H.P. when running at 650 revolutions per minute, is illustrated in fig. 3. The motors are of the slotted type, and are constructed generally in accordance with the specification for the generators.

An especially notable point in connection with these machines is the exceedingly low speed at which they are rated for their full output, this varying from 800 revolutions per minute in the smaller sizes to 400 revolutions in the larger.

Nine distinct sizes have been standardised, ranging from 2 to 50 B.H.P. All the various parts going to make the complete machine are constructed to jigs and templates, similar parts being interchangeable, so that any piece may be supplied immediately from stock. The semi-enclosed type motors will run continuously at full load with a temperature increase of 40° C. (72° F.) above that of the surrounding air, and the brushes are fixed for all loads.

Many thousands of these machines have been supplied since their introduction, and they appear to give complete satisfaction under strenuous conditions of operation.

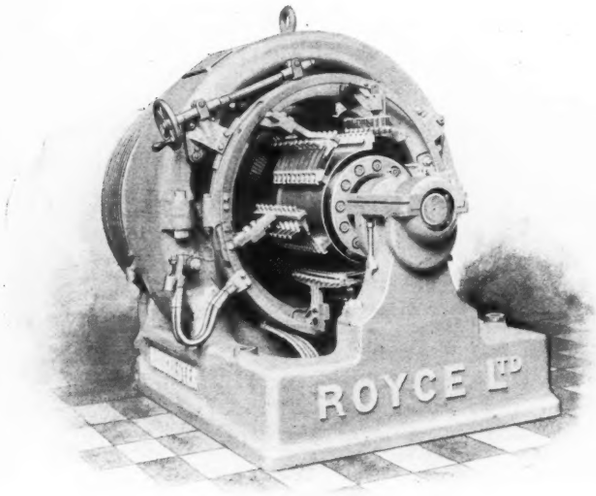


FIG. 2.

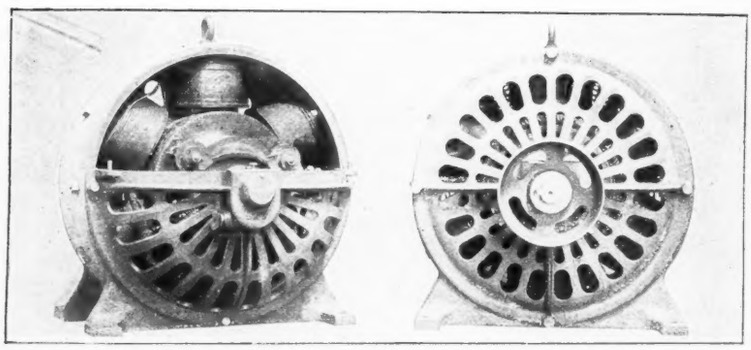


FIG. 3.

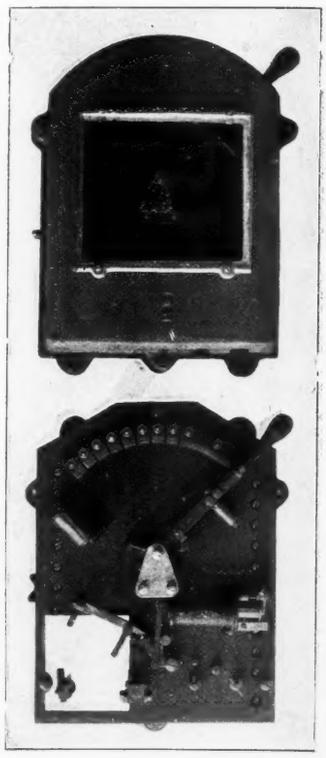


FIG. 4.

In order to meet the demand for a satisfactory motor-starting switch, the firm have designed and perfected the starter, illustrated in fig. 4; the construction of this will be readily seen from the figure. These starters have several distinctive features about them; the circuit is always broken by a main switch at a position where ample provision is made for a long break between easily renewable carbon contracts; a braking and trip device is fitted in order to prevent the motor being started too quickly, and this can be regulated so that the machine is brought up to speed in not less than from 15 to 30 seconds.

Messrs. Royce have also made a speciality of controllers for cranes and similar work; the design of these is illustrated in fig. 5, and is similar to that used for tramcar service, and the various operations of starting, regulating, reversing and otherwise manipulating the motors can be effected in the controllers.

Another of the firm's specialities is the manufacture of

electrically-driven overhead and "Goliath" cranes, hoists, capstans, &c. In fig. 6 is illustrated one of their 25-ton electrically-driven "Goliath" cranes, similar to many which have been supplied to various railway companies, shipyards, engineering works, &c. The illustration in question shows the crane at the Marylebone terminus of the Great Central Railway, London.

The span is over 0 ft., with head room underneath the girders of 21 , and the full load of 25 tons is arranged to be lifted a speed of 5 ft. r minute. Lighter ads can be moved an inverse ratio, load of 5 tons ing raised at 25 . per minute. The raversing and avelling speeds are 0 ft. per minute.

The construction ers many points f interest; the box irders of mild teel, 4 ft. 6 in. eep in the centre by 16 in. wide, form the framework on hich the stability of the structure depends, and special are is taken that the weight of the crane is evenly distributed over the eight longitudinal travelling wheels by the use of compensating levers pivoted under the centre of each of the four uprights.

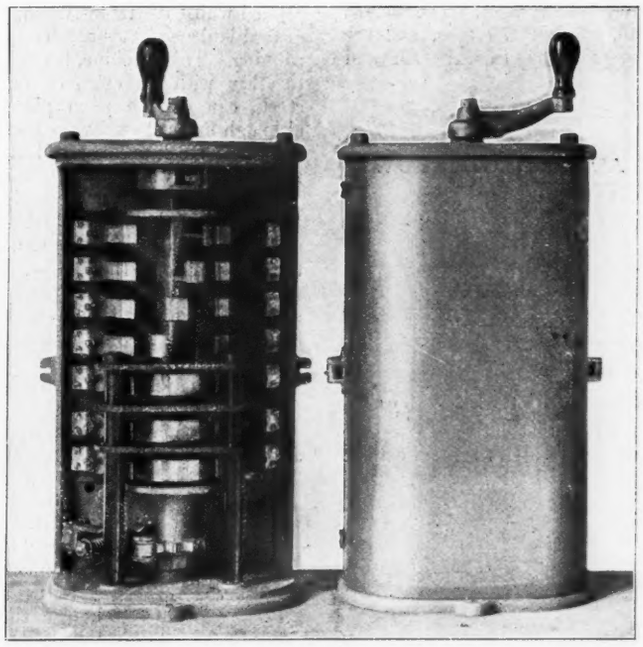


Fig. 5.

Special attention is given to the bearings, the running friction and power required for the various motions being very small, and consequently giving a high efficiency and low cost of working. All bearings are arranged to swivel on their centres, thus ensuring even distribution of load over the entire length of the wearing surface.

The crab side frames are constructed of stout steel plates stiffened by strong angles. The shafts and axles are so arranged that they can be lifted out directly, in this way avoiding the inconvenient and troublesome method of threading shafts often adopted by crane builders.

The motor for the longitudinal travelling motion is fixed upon supporting brackets attached to the centre of one of the main girders in order to equally distribute the propelling forces and prevent the possibility of cross-winding upon the rails. The cross-traversing and hoisting motors are mounted upon the crab. The whole of the motions are controlled from the cabin shown in the illustration, where the necessary controllers and resistances are fixed. An excellent provision embodied in this crane, in accordance with the general practice of crane makers, is that of an

Fig. 6.

automatic magnetic brake, which is combined with the hoisting motor. The act of switching off, or the interruption, from any cause, of the supply of current, without any attention on the part of the operator, automatically releases the brake, and allows it to take charge of and sustain the load in whatever position it may happen to be at the time. The weight of this Goliath, with its load, is about 75 tons, and the design is characterised throughout by the strength and solidity of its parts.

MACHINE TOOLS AT THE GLASGOW EXHIBITION.

(In Special Reference to the Requirements of Dynamo and Motor Manufacturers.)

By FRED. BATHURST, A.M.I.E.E.

(*Continued from page* 23.)

New Hexagon Turret Lathes.

As we made mention of the fact that lathes of one type or the other were the predominant feature of the tool exhibit in the Exhibition, so we must, before concluding, refer to an exhibit hitherto unmentioned. Passing into the special machinery pavilion erected by Messrs. Chas. Churchill & Co., of Leonard Street, London, E.C., in the North Gardens of the Exhibition grounds, we found an extensive display of their engineers' and mechanics' fine tools. In this pavilion alone many hours, or even days, could have been well spent in bringing oneself up to date in the detail improvements of every class of tool.

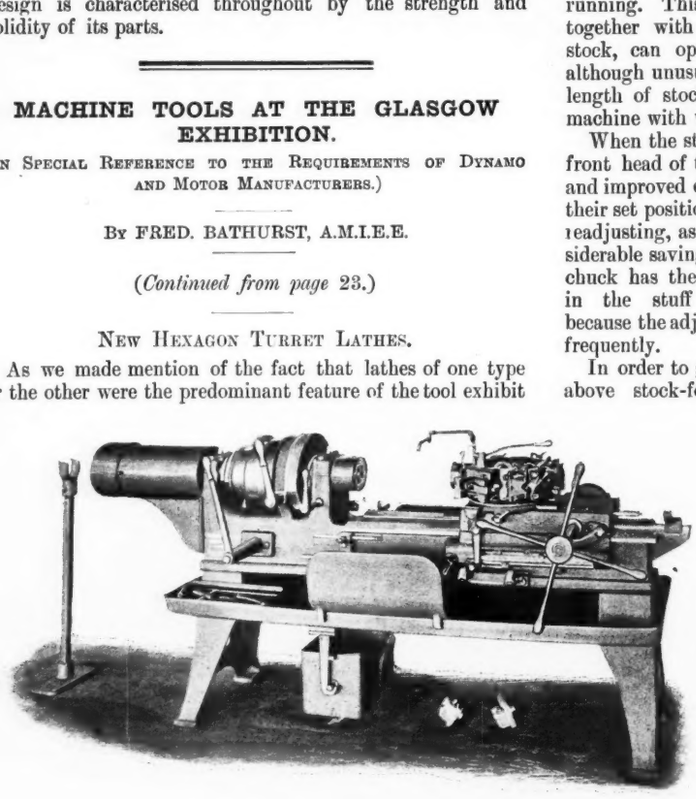


Fig. 19.—Turret Lathe.—Front View.

Probably it would be considered that their "star" exhibit was a Warner & Swasey hexagon turret lathe (shown in front and back view by figs. 19 & 20). The class of work that can be done on this machine is the manufacture of bolts and heavy machine screws up to 2 in. diameter and 2 ft. long, as required, for instance, for dynamo sliding rails.

One of the special new features incorporated for the first time in a machine of this type is a *roller feed* for the stock being worked upon. The stock in hand is operated by a small scroll chuck, which grips by means of the rollers, and *self-centres* the work at the same time.

Hitherto this type of lathe has only been provided with a set screw method of centring the stock, which not only requires time, but calls also for care and exactness on the part of the operating machinist. This new roller feed can be operated either whilst the machine is standing still or running, which means that when making long bolts the stock can be fed through rapidly to the desired length by operating the same lever which closes the chuck on to the stock.

On the usual type of machine, feeding can only be accomplished whilst the lathe is running, and thus the quickness of feed is dependent upon the speed at which the lathe is running. This machine, being provided with a hollow head, together with the extra convenience for feeding lengths of stock, can operate upon pieces 12 to 16 ft. long, which although unusual are by no means unwieldy; this increased length of stock means that less time is lost in refilling the machine with work.

When the stock is run completely out of the chuck in the front head of the machine (that nearest the turret) a new and improved device allows the gripping jaws to still retain their set position—that is, they do not drop down and require readjusting, as in the ordinary type of lathe. Whilst a considerable saving of time is thus effected, this new design of chuck has the further advantage that the variation of size in the stuff worked does not become a disadvantage, because the adjustments for variation have not to be made so frequently.

In order to gain fully every advantage possible from the above stock-feeding arrangement, an improved form of turret has also been adopted, which has the gauging stop fixed directly upon it. This arrangement ensures the *exact* length of stock being fed forward upon every occasion.

In the type of lathe at present known, there is always an amount of "play" caused by the gauge stop working on a lever, a construction which in itself permits a certain inaccuracy. On this new design W. & S. hexagon turret lathe the most accurate work can thus be turned out in a minimum of time.

As regards its power and general stability, a further improvement has been made by placing the feed rack in the centre of the bed, instead of arranging it as is commonly done on the side. In this way the rack receives a true thrust, and the saddle must centre itself truly to the stock being worked.

Messrs. Charles Churchill & Co. point out with noticeable satisfaction that the above improvements have not increased the first cost of the tool, and they find that manufacturers, knowing of the improvements effected in this class of tool, are giving them the preference, and are placing orders with them.

Another of this firm's exhibits which must claim a short notice, is the Cleveland automatic screwing machine, which in its original design formed the pattern upon which other makers standardised this class of machines. This new type is also arranged to meet variation of the stock being worked upon,

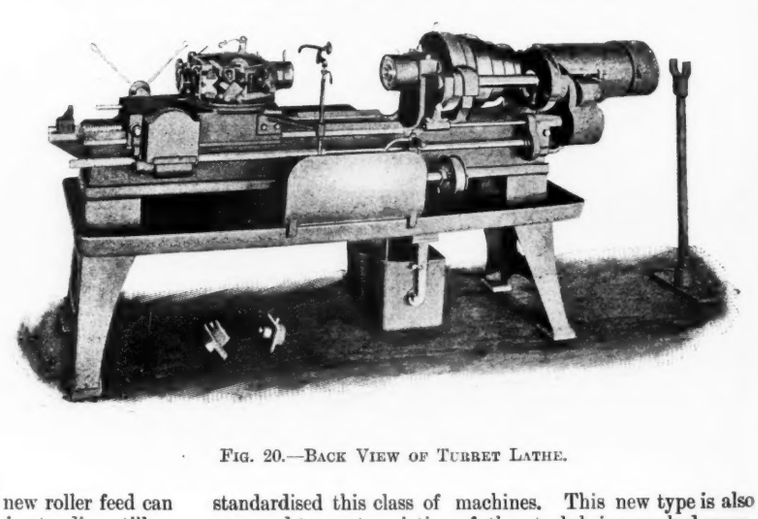


Fig. 20.—Back View of Turret Lathe.

since all its feed plates and cams are made adjustable, a point which other makers have not yet had time to imitate.

The idea of securing the central thrust upon each turret tool (similarly to that referred to above) is well carried out on the Cleveland make of machine. It should be remarked that in all other automatic screwing machines the individual tool revolves in a horizontal plane relative to the spindle carrying stock, and, consequently, the smallest give or play on the turret spindle tends to make the stock run out of truth.

In exhibiting the planing machines made by the well-known firm of Gray, of Cincinnati, U.S.A., a novel magnetic clamping chuck is shown in operation. These magnetic chucks, which are arranged in the sliding work-table, are particularly useful for fastening down to the planing bed any thin work which must be planed perfectly true, and yet has not body or strength enough in itself to bear "cramping down" with the ordinary clamps. This magnetic chuck is made by S. Walker & Co., of Worcester, Mass., U.S.A., and is already meeting with extended use in American machine shops, being particularly applicable to the pieces handled in the shop tool rooms, and those English firms to whom it has been introduced have immediately recognised its utility and application.

(To be continued.)

ELECTRIC TRACTION NOTES.

(*Continued from page* 98.)

The Edinburgh Cable Tramways.—*Feilden's Magazine* contains an article on the Edinburgh cable tramways, by Mr. Benj. Taylor, which, we think wisely, does not propose to compare the relative merits of cables and electricity. The Edinburgh cable system now covers 42 miles of track, or 21 miles of street, and was put down by the advice of Prof. Kennedy, as the best he could advise to meet the supposed æsthetic conditions of the city. In Edinburgh, the usual difficulty which compels a car to pass full speed round corners is got over by slow running auxiliary cables and a new type of gripper. The auxiliary cable is driven by the main cable. The grippers have two sets of jaws, one each side of the shank. Necessarily there is some delay in picking up and letting go the two cables as required. In all there are 48½ miles of cables, and an engine power of 4,100 H.P., of which 2,600 H.P. is in use, or about 15 H.P. per car. There are 173 cars, or thereabouts. The power is thus in excess of what would be required electrically; this would probably average about 1,400 H.P., with a maximum considerably more, but the article before us gives no really useful figures in this respect. Just at present the Sunday running of the Edinburgh cars has directed particular attention to the system, which, we think, was put down from an entirely erroneous idea as to the effect of the trolley wire system on the beauties of Edinburgh as a city. The cable system has certain mechanical economies often quoted in its favour, as, for example, the saving of the energy of down-grade cars. But is not this obtained at a constant expenditure of energy upon the cable itself out of all proportion to the saving?

Erith.—At the Council meeting a letter was read from Mr. Baynes, clerk to the Bexley Council, stating that the Council had obtained powers to construct electrical tramways, and one of the first routes to be laid would be to Northumberland Heath. It was thought that Erith would like to know what Bexley was doing, in order that they might take steps, if thought desirable, to make connections.

Exeter.—The Electric Traction Committee has appointed a sub-committee to obtain information from other towns *re* motor 'busses, electric cars, and other means of passenger transit.

Farnworth (Bolton).—Major Druitt has made the official inspection of the Farnworth electric trams. A number of cars have been bought from the British Westinghouse Company, and the British Insulated Wire Company have carried out the work of equipment.

Gloucester.—The City Council has resolved to recommend the purchase, for £26,000, of the undertaking of the Gloucester Tramway Company, subject to the sanction of the Board of Trade, and to the granting by the Light Railway Commissioners of an order similar to that already secured by the Tramway Company, which would empower the Corporation to construct and work an extended system of electric trams in the city and environs.

Gosforth.—At the meeting of the Gosforth Urban District Council, held on the 9th inst., a report of the committee on two rival tramway schemes was considered. One was that of the Newcastle-on-Tyne Corporation and the other was that of the Tyneside Tramways Company. On the recommendation of a committee the Tyneside Company's Bill was assented to by the Urban District Council, conditionally, and the Newcastle Corporation's Bill was dissented from. One of the points in dispute between the Tyneside Tramways Company and the Council is in regard to the question of purchase.

Hebden Bridge.—The Hebden Bridge Urban District Council's dispute with the Halifax Corporation still continues with respect to the side of the roadway on which the tram poles shall be erected. The parties have this week agreed to submit the matter to the Local Government Board. There is also a dispute between the parties with respect to the supply from H lifax of electricity in bulk. Hebden Bridge wants the charges reduced for the supply of electricity in bulk, and the Halifax Corporation will not entertain the request.

Hove.—The T.C. has resolved to provide a municipal system of trams in the borough. The most strenuous opposition will be made to any proposal of any outside body to promote and work tramways. Steps are to be taken as soon as possible to promote a Bill in Parliament to provide tramways, and if thought desirable on further consideration, to acquire the tramways now working and running to Shoreham, and to work the same.

Levenshulme.—The D.C. have resolved to apply for sanction to a loan of £13,000 for the conversion of the tramlines in the district to electric traction.

Light Railways.—The Board of Trade has recently confirmed the following light railway orders:—Jarrow and South Shields Light Railways Order, 1901; Worcester and District Light Railways Orders, 1901; County of Middlesex Light Railways Order, 1901; East Sussex Light Railway Order, 1901; Barton-upon-Irwell Light Railway Order, 1901; Loughborough and District Light Railways Order, 1901.

Limerick.—On Thursday last week the Judicial Committee of the Irish Privy Council sat to hear an application by the promoters of the Limerick Electric Tramway for an Order in Council to authorise the undertaking. Formal evidence of the approval of Limerick Corporation, and that the electricity would not be used for other purposes, having been heard, Mr. Fraser, C.E., said that the tramway, which would cost £60,000, would extend over six miles. The matter was then allowed to stand for four months for further evidence as to the financial position of the promoters and the necessity for increasing the capital.

Liverpool.—Speaking at a public meeting last week, Mr. S. W. Higginbottom, M.P., chairman of the Corporation Tramways Committee, referred to the working of the tramways during the past year. In 1897 they had in Liverpool, he said, a tramway mileage of 6,013,180, and they carried 38,400,084 passengers. At the close of 1901 they had a mileage of 10,970,063, and during the year they had carried 101,108,780 passengers. The receipts from the tramways were £468,383, an increase of £50,809 on those of the previous year. The Committee hoped to hand over a surplus of £60,000 to the Council to be used as they thought fit, but he hoped that before spending the money the Council would see to it that they built up a strong reserve so as to ensure that their system of tramways would be maintained as the best of its kind in the world.

London.—The *Daily News* says that the work of laying the conduit system on the Tooting and Westminster route will be commenced in the middle of March, and it is hoped that the new cars will be running in about 10 months' time. In all probability operations will be started in the Southern district. A ruling principle will be that the roads through which the coronation procession will pass must not be disturbed until after the coronation ceremony. The work will be done in sections, from which the ordinary horse tramway traffic will be diverted until they are completed. Generally speaking there will be no night operations. It is said that night work is twice as costly and half as efficient as day work, and except in certain places, such as busy crossings, the whole of the work will be performed in the daytime.

London—Brighton Railway.—The promoters of the London and Brighton Electric Railway are stated to have deposited the sum of £370,000 as a guarantee that the Bill will be proceeded with in the ensuing session. The estimated cost is £7,338,403.

Maidenhead.—The T.C. thinks of applying for light railway powers, and instructing the borough surveyor to prepare plans and particulars, &c., for the construction of lines.

Manchester.—A guard wire broke in Deansgate last Saturday morning, and came into contact with the live wires. The cars were at a standstill for half an hour.

Manchester—Liverpool.—The annual general meeting of the syndicate responsible for the promotion of the mono-railway between Manchester and Liverpool was held on 14th inst. Mr. J. H. Macmillan, of Manchester, who presided, said that the year's delay, which had been caused through the very bitter opposition of the railways, had not been altogether a loss. It had enabled the projected line to be improved in certain respects, and more important than that, the prolonged and most minute examination of the Parliamentary Committees had established beyond reasonable question not only the engineering feasibility, but the commercial practicability of the scheme.

Middlesex.—The Board of Trade have confirmed Light Railway Orders for Edgware, Finchley, Friern Barnet, Hendon, Hornsey, Kingsbury, Little Stanmore, Southgate, Tottenham, Wembley, Willesden, and Wood Green.

Morpeth District.—One of the latest schemes for north country tramways is that for the construction of which the Northern Counties Electrical Supply Company, Limited, are seeking power. It is proposed by the promoters to lay a tramway down from Morpeth to Bedlington (the terrier village), a distance of 7¾ miles, a second line from Bebside to Blyth, 3½ miles, and a third from Ashington to Newbiggin, which is about 4¾ miles. These tramways will tap important areas in the heart of the Northumberland colliery district, and prove an immense convenience to the localities. Morpeth and Bedlington, and Bebside and Blyth, are connected directly with each other by the railway, but that is not the case as regards Ashington and Newbiggin.

Pneumatic Brakes.—It will be remembered that a somewhat serious accident recently occurred with a runaway car in the Potteries district. Since the accident the patent pneumatic slipper brake of Messrs. Hewitt & Rhodes, of Manchester, has been fitted to the car, and on Friday, the 3rd inst., the brakes were tested on the same hill on which the accident occurred. The car was taken to the top of the incline, and full speed applied by means of a controller to the car, until it attained a speed of about 25 miles per hour on an incline of 1 in 14; on the H. & R. slipper brake being applied, the car was brought up in two lengths of itself. General satisfaction was expressed by the officials of the company who were present at this severe test.

Ramsgate.—Extensions of the electric tramway system are contemplated, and by next season the service will probably be considerably augmented.

Sale.—A letter has been sent to the U.D.C. by the Manchester Suburban and Electric Tramway Company stating that they propose to construct a tramway from Sale to Stalybridge, and are about to make application for Parliamentary powers.

Scalp and Enniskerry Tramways.—The application to the Privy Council for the promotion of this line was made last week, and petitions against it were lodged by the Dublin, Wicklow and Wexford Railway, and the Bray and Enniskerry Railway. For the promoters it was stated that the intended line was to be run from Dublin, through the Pembroke Township and Dublin County to the point near The Scalp, where it would pass into the co. Wicklow. The Bray Urban Council have signified their approval of the project, subject to certain conditions. The Bray and Enniskerry Railway Company obtained an Act of Parliament in 1891, but had only completed one mile of the line. The promoters of the projected line purpose raising £200,000 to build it. The Lord Chancellor, after hearing the various sides, said that taking into consideration the objections of the Dublin, Wicklow and Wexford Railway, he thought it would be necessary to again consider the scheme as a whole.

Sedgley.—On Wednesday last week the British Electric Traction Company opened their new electric line from Sedgley to the Fighting Cocks, a 20 minutes' service. The opening of the line, which was inspected by the Board of Trade three months ago, has given great satisfaction to the public, and the cars have been largely patronised. The delay in working the line arose through a dispute with the Post Office authorities respecting the telegraph wires.

South Shields.—The general chaos which exists at South Shields in respect to the trams has been slightly intensified by the ballot, the result of which was made known on Thursday night (9th inst.). The position, so far as one is able to grasp it, is something like this. Some years ago the tramways in that borough were leased to the British Electric Traction Company, Limited, which company no doubt took them up with the idea of converting them into electric trams at the earliest opportunity. This lease expires in 1905. In March, 1898, the company attempted to negotiate with the Corporation of the borough with a view to the immediate electrification of the existing tramways and the construction of new routes, but to these proposals no definite answer was ever given. Meanwhile matters have become more involved. The British Electric Traction Company, Limited, obtained powers for the construction of the Jarrow and South Shields Light Railway, and these tramways (for such they are practically) are empowered to run into the very heart of South Shields, to the end of Fowler Street. Recently, as will be remembered, the British Electric Traction Company applied for powers to construct a light railway from Sunderland to South Shields, and this line would terminate at the end of Fowler Street, meeting the first-mentioned line at right angles. The latter powers have not yet been granted, but the company are now carrying their appeal for powers to Parliament, and the Bill will come up during the present session. Meanwhile the Town Council prepared a Bill and sought to obtain formal sanction of the burgesses to its promotion. At the town's meeting held for that purpose a poll was demanded, with the result that the Bill was rejected by the people by a majority of 226 votes. The position at present is that the Corporation (who by their Bill sought powers to construct and to work or lease the trams) cannot go on with their Bill, they have formally opposed the scheme of the British Electric Company, and municipally matters are at a standstill. The interesting character of the struggle is intensified by the fact that if the British Electric Traction Company carry their Bill for the South Shields and Sunderland Light Railway they will have running powers over two-thirds of the present system.

Swindon.—The special sub-committee have conferred with Mr. Lacey (of Messrs. Lacey, Clirehugh & Sillar) with regard to the construction of the tramways. It appeared that under the Tramways Act, 1870, the tramways are to be constructed within a period of two years from the date of the confirmation of the Provisional Order. This date is August 9th, 1901, so that the tramways should be completed and open for traffic by August 9th, 1903. The sub-committee, however, considered that it was of the greatest importance that the tramways should be ready for traffic as soon as the electricity generating plant was at work. They recommended, therefore, that it be an instruction to the engineers to revise their Parliamentary estimates for tramways Nos. 1 and 2 authorised by the Provisional Order, with a view to the construction of these tramways being proceeded with in accordance with the resolution of the Corporation of June 5th, 1900, and to make provision in these estimates for complying with the requirements of the Board of Trade with regard to canal bridges. In order to avoid delay, it was recommended that immediate application be made to the Board of Trade for the necessary borrowing powers. The report of the sub-committee was adopted.

Messrs. Lacey, Clirehugh & Sillar reported on the tenders for the supply and delivery of three Lancashire boilers, &c., water-cooler, and travelling crane, for the generating station, and it was resolved that the tender of Messrs. Carter & Sons, Stalybridge, be accepted for three Lancashire boilers at £6,667; and the tender of Messrs. Couper, Swarz & Co., Liverpool, be accepted for a water-cooler at £535, and that of Messrs. Carrick & Ritchie, Edinburgh, for a travelling crane at £235.

Wolverhampton.—Our local correspondent sends us the following:—"At the meeting of the Town Council on Monday, the following resolution was passed:—'That subject to the consent of the Lorain Steel Company being obtained, the Tramways Committee be, and they are hereby, empowered to give notice to the company, as provided by Clause 8 of the contract between the Corporation and the company, to proceed with the equipment of the whole of the remainder of the route mentioned in the said clause as soon as the Board of Trade's approval of the system, construction of track, and general working has been obtained, notwitstanding that the period mentioned in the said clause may not have expired.' This means that, so far as the Town Council are concerned, the members consider the Lorain surface contact system of electric traction to be a success, and that therefore to expedite the work of completing the new tramway service, they are desirous now to equip the remainder of the route, even though the 30 days' test under working commercial conditions has not been applied to the experimental mile on the Bilston Road. This mile was officially inspected on Tuesday by Colonel Yorke, with whom was Mr. Trotter, on behalf of the Board of Trade. There were also present Alderman C. T. Mander (chairman of the Tramways Committee), Mr. Brown (the inventor of the Lorain system), Mr. Whitmore (of the Lorain Company), Mr. Green (the borough surveyor), and a number of officials. A single and double-decker car were run up and down the line, every point of detail in connection with the track, as well as the electric equipment, being minutely examined. The skate underneath the cars left a mark on each of the stud-boxes, thus showing the effectiveness of the electric contact; and a big crowd of people, including many labourers in hob-nailed boots, walked on the studs without being subjected to the slightest shock. As a result of the inspection, Col. Yorke has intimated his willingness to give a certificate to run the cars on the experimental mile at once."

An arrangement has now been concluded between the Corporation and the British Electric Traction Company whereby, when the Corporation tramway lines are ready, communication with the outlying districts of Sedgley, Bilston, and Willenhall—which was broken off when the Corporation purchased the tramways—will be restored.

Twickenham.—The *Richmond and Twickenham Times* last Saturday contained a three-column report of the special U.D.C. meeting the previous evening, when tramway matters were discussed. The chief points arose on details of widening, interlaced lines, and the use of the wood paving, all of which were amicably arranged, and in a manner likely to be assented to by the L.U.T. The London United Company's service main for the Richmond and Hampton Court line has been laid through Twickenham, except at points where scheduled property has not yet been acquired.

Wigan.—We stated recently that Mr. Slevin had been appointed manager, and Mr. Dewse secretary to the Corporation tramways department. This, we learn, is incorrect. Mr. Dewse has been appointed accountant to the electric light and tramways department, and Mr. Slevin traffic manager. Mr. Collings Bishop has always been engineer and general manager to both departments.

Last Saturday the Corporation confirmed the agreement for the purchase of the Wigan Tramways Company's undertaking for £45,000.

TELEGRAPH AND TELEPHONE NOTES.

Durban Telephones.—The Town Council has given notice to the local Telephone Company that in terms of law, the company's undertaking will be taken over by the Corporation in three months' time. The value will be fixed by arbitration.

Glasgow Telephone System.—The Glasgow Corporation have agreed to apply for further powers to borrow an additional £100,000 for further extensions to the telephone system. At a recent meeting it was stated that they had 6,000 subscribers on the books, of whom 3,012 were now connected up. The chairman

Tyneside Tramways Company. On the recommendation of a committee stated that the financial aspect of the department was satisfactory, and that convincing details regarding this would be published in June.

The Corporation have had to apologise to the Burgh of Govan on account of the telephone department workmen lifting the streets in that burgh without the burgh surveyor's permission.

Telegraphic Breakdowns.—In connection with the telegraphic breakdowns which occurred in November and December, cutting off Scotland entirely from London and the English Midlands, the Edinburgh Chamber of Commerce and the Glasgow Chamber of Commerce have arranged to send a deputation to the Postmaster-General to urge the adoption of underground telegraphic communication. The Glasgow Chamber stated that the recent breakdown had cost the Post Office a quarter of a million outside the loss to commercial interests, and that the breakdown a year ago cost £100,000. It is suggested that a cable be laid from the Thames to the Firth of Forth, with connections for Glasgow and Edinburgh. A cable of this character, it was stated, would cost £110,000 to lay. At the present rate of laying underground wires, as between London and Birmingham, it will be 10 years before Scotland is reached.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	..
Mole St. Nicholas-Port au Prince	Dec. 28, 1901 ..	..
Coro-Maracaibo (Venez.)	Jan. 8, 1902 ..	..
Landlines :—		
"*Via* Hanekin" on Persian territory	Feb. 24, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..
Cap Haitien-Port au Prince	Jan. 14, 1902 ..	..

The Telegraphic Wire Export Trade.—As usual, December proved a quiet month as regards the exports of telegraph wire and apparatus connected therewith from this country, the shipments attaining a value of only £37,572, as compared with £272,764 in November last, and £39,166 in December, 1900. Taking last year as a whole, it proved to be one of the most active, if not, in fact, the busiest ever recorded in this branch of industry, the exports during the 12 months attaining a value of no less than £3,176,175, as against £2,801,401 in 1900.

Trunk Telephones in Ireland.—The Postmaster-General, in replying to a memorial of the Association of Chambers of Commerce relative to the development of the telephone system in the South of Ireland, says he has caused inquiry to be made as to the probable cost of providing telephonic communication between Cork and Youghal, Mallow, Killarney, Fermoy, Dungarvan, and Waterford. He regrets, says the *Times*, that the cost would be too considerable to justify him in recommending the case to the Treasury unless a guarantee were forthcoming in respect of revenue from calls passing over the circuits. After naming the annual guarantee on a seven years' agreement, the Postmaster-General says that if guarantees are forthcoming he will be prepared to provide local connections to subscribers' premises at an annual charge of £7 10s., under a three years' lease, for circuits within a radius of half a mile from the post office, with an additional charge of 25s. for each quarter-mile, or part thereof, beyond the radius. Subscribers at these rates would be entitled to communicate over the trunk wires, on payment of the appropriate fee, with subscribers of the Post Office, the National Telephone Company, and other licensees in all towns of the United Kingdom connected with the trunk wire system. It would not, however, be practicable to afford intercommunication between the subscribers of the Post Office and the National Telephone Company situated in the same exchange area.

Wireless Telegraphy.—A scientific contributor to the Paris *Figaro*—M. Emile Gautier—says the *Evening Standard* of Wednesday, dealing with the question of wireless telegraphy and the Marconi experiments, reaches the conclusion that neither to-day nor to-morrow will it be found that submarine cables have outlived their usefulness. It required, as it is recalled, some 30 years for the telephone to emerge from what may be called the toy-stage, and establish its claims to practical utility and commercial value. Similarly, it may be forecasted, as the writer in the *Figaro* points out, that years will elapse and decades pass by before wireless telegraphy and aerial navigation are developed to the point needed to class them with inventions of real utility. But in the meantime the progress made in these branches of science will be followed step by step with genuine interest by reflecting men.

Wireless Telegraphy in the Italian Fleet.—The Italian fleet in the Mediterranean last month commenced experiments in wireless telegraphy on Marconi's system, near Gaeta. To the fleet has been added the torpedo boat N. 75 S., which has been fitted up with the apparatus required for the experiments.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—January 24th. Additional generating plant for the Council's electricity works. See "Official Notices" December 20th.

Belfast.—January 17th. Cables, roadwork, conduits, &c., for the Electrical Committee. See "Official Notices" January 3rd.

Belgium.—February 15th. Proposals are being invited by the municipal authorities of Lourain for the lighting of the public streets by electricity or gas.

Belgium.—March 1st. The municipal authorities of Ghent are inviting tenders until the March 1st, 1902, for the concession for an electric lighting installation. See our "Official Notices" January 3rd.

Blackburn.—January 27th. Engineering stores for the electricity and tramway departments for one year; also oils and greases for ditto. See "Official Notices" to-day.

Bootle.—For wiring public baths, library, &c., in Marsh Lane, Bootle. Specifications, &c., from Borough Electricity Works, Pine Grove (one guinea).

Cardiff.—January 22nd. Two 1,600-I.H.P. vertical engines, and two 900-KW. generators for the Tramways Committee. See "Official Notices" January 10th.

Egypt.—January 18th. Electric lighting of Suez and Damanhour. Particulars from the Minister of Public Works, Cairo.

Fulham.—January 27th. Twenty 50-KW. transformers, mains, conduits, lamp-posts and street boxes. See "Official Notices" January 10th.

Glasgow.—January 17th. Overhead tramway equipment (material, poles and fittings), for the Corporation. See "Official Notices" January 10th.

Grimsby.—January 20th. Steam dynamos, switchboard extensions, battery, condenser, piping, water-tube boiler for electricity works. See "Official Notices" December 27th.

Hartlepool.—January 25th. Buildings, marine boilers, engines and dynamos, battery, switchboard, arc lamps, columns, mains, and cranes, for electricity supply works for the Corporation. See "Official Notices" January 3rd.

Hunslet.—January 21st. Electrical equipment of the new workhouse and infirmary at Bothwell Haigh for the Guardians. See "Official Notices" January 3rd.

Ilford.—January 27th. Rail-bonds, conduits, drawboxes, &c., for the U.D.C. tramways. See "Official Notices" January 10th.

Lancaster.—January 23rd. 200 and 300 KW. steam dynamos, boilers, switchboard and crane, for the Corporation. See "Official Notices" January 10th.

Llanelly.—January 20th. The Harbour Commissioners want tenders for electric lighting plant for the new dock at Llanelly. 25-B.H.P. engine and dynamo; 16 arc lamps and 30 incandescents (16-C.P. and 32-C.P.). Specifications (10s. 6d.) from Mr. J. V. Stewart, Harbour Offices, Llanelly.

L.C.C.—January 28th. The L.C.C. is in the market for about 3,250 tons of track rails; 1,850 tons of slot rails; 670 tons of conductor tee rails; fishplates, bolts, nuts, &c., required in connection with the reconstruction of tramways for electric traction. Specifications, &c., at the County Hall, Spring Gardens, S.W., upon payment of £2.

Manchester.—January 18th. The Tramways Committee wants tenders for the supply of overhead equipment, tools, &c.

Manchester.—January 21st. Three-phase switchboards, exciter and auxiliary ditto, three-phase boards for sub-stations, low tension boards at sub-stations at the Stuart Street generating station. See "Official Notices" December 20th.

Manchester.—January 28th. Coal and ash elevating and conveying plant for the Stuart Street generating station of the Corporation. See "Official Notices" to-day.

Middlesbrough.—January 21st. 300-KW. engine and dynamo, switchboard panels, ejector condenser, feed pump and economiser for the electricity works. See "Official Notices" December 20th.

Middleton.—January 21st. The Corporation invites tenders for the supply of electricity meters.

Rochdale.—February 2nd. Lighting switchboard extensions for the Corporation. See "Official Notices" to-day.

Rockhampton (Australia).—March 31st. The Council of the Municipality of Rockhampton is prepared to consider applications from companies desirous of undertaking the construction and working of a system of electric tramways under the Queensland Tramways Act of 1882, and the Amendment Act of 1890. See Electrical Review, January 10th.

St. Pancras.—January 17th. Engines, dynamos, condensers, piping, boilers, pumps, &c., for the Borough Council. See "Official Notices" January 3rd.

under the Tramways Act, 1870, the tramways are to be constructed within a period of two years from the date of the confirmation of

recent meeting it was stated that they had 6,000 subscribers on the books, of whom 3,012 were now connected up. The chairman

South Africa.—Tenders are invited for the erection of new power houses and offices at Claremont and Wynberg for the Cape Peninsula Lighting Company, Limited. Applications to be made to H. T. Jones, Architect, 12, Short Market Street, Cape Town.

South Lancashire.—January 29th. Two-phase motor-generators, boosters, and batteries for the S.L.E.T. and Power Company. See "Official Notices" January 10th.

Spain.—January 26th. The municipal authorities of Sahagun (province of Leon) are inviting tenders until the 26th inst., for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Sahagun (Leon).

Spain.—January 27th. Tenders are being invited by the Spanish Ministry of Public Works in Madrid until the 27th inst., for the concession for the construction and working of an electric tramway between Tolosa and San Sebastian (Guipuzcoa province). Tenders are to be sent to El Ministerio de Obras Publicas, Madrid, whence particulars may be obtained.

Sunderland.—February 6th. 10 double and four single-deck car bodies, trucks, &c. See "Official Notices" to-day.

Walsall.—January 31st. One each 500-H.P. and 25-H.P. high speed engines, and 350-KW. and 16 KW. dynamos for the electricity department. See "Official Notices" to-day.

Warrington.—January 28th. Feeder cables for Corporation tramways. See "Official Notices" to-day.

West Bromwich.—January 17th. Rails, points, crossings, drain rails, road work, bonding, trolley poles, overhead line work, section boxes, cables, &c., for electric tramways for the Council. See "Official Notices" December 20th.

West Bromwich.—January 29th. Boilers, dynamos, booster, switchboards, condenser, &c. See "Official Notices" January 10th.

CLOSED.

Bradford.—The City Council has accepted the offer of Estler Bros, Limited, to supply 20 panels for section boxes at £13 13s. per panel, and the offer of Hadfield's Steel Company, Limited, of Hecla Works, Sheffield, to supply the manganese steel rail joints and crossings required at the junction of the Manchester Road and Leeds Road lines for the sum of £855 10s. The City Council has determined that the whole of the Bradford cars shall be fitted with the British Electric Car Company's patent destination indicators at an estimated cost of £5 per car.

Dewsbury.—The following is a list of tenders sent in for two 100-KW. dynamos for the Dewsbury Corporation Electricity Department:—

Maker's name.	Price for two new machines.	Price for spare armature.	Total.
Siemens Bros. & Co., Ltd. .. .. (accepted)	£625	£132	£757
T. W. Broadbent	658	146	804
Union Electric Co.	667	140	807
Lancashire Dynamo Co.	715	156	871
British Schuckert Co...	760	175	935
International Electric Co.	770	170	940
Royce, Limited	760	210	970
Johnson Lundell Co.	793	193	986
Thames Ironworks Co.	798	210	1,008
Crompton & Co., Ltd.	846	180	1,026
Mather & Platt	850	178	1,028
Bertram Thomas	871	158	1,029
A. Hirst & Son Ltd.	850	180	1,030
Greenwood & Batley	908	125	1,033
Electric Construction Co.	894	140	1,034
Lahmeyer Electrical Co.	845	205	1,050
Brush Electrical Engineering Co.	880	174	1,054
Bruce Peebles & Co.	900	175	1,075
Sunderland Forge Co.	986	130	1,116
Thomas Parker, Ltd.	919	198	1,117
Johnson & Phillips, Ltd.	1,010	210	1,220
Electro-Motor and Dynamo Co. *	1,040	180	1,220
Clayton Engineering Co.	1,042	195	1,237
Phœnix Dynamo Co.	1,120	210	1,330

* Not to specification.

France.—The French Ministry of Posts and Telegraphs in Paris has just given out contracts as follows:—25 kilometres of submarine cable core, the India-Rubber and Gutta-Percha Company, of Persan—Beaumont (Seine et Oise), at 24,375 fr.; 60 kilometres ditto, M. Grammont, of Pont de Chery (Isère), at 68,700 fr.; and 60 kilometres ditto, La Société des Telephones, of Paris, at 77,400 fr.; 30 tons of iron wire, 8 mm. diameter, Les Forges de Franche Comté, of Besançon, at 8,490 fr.; and 30 tons ditto, La Société Metallurgique de Gorcy (Meurthe et Morselle) at 8,070 fr.

Hammersmith.—The Borough Council has accepted the tender sent in by Callender's Cable Company, for supplying cables, &c., for electric light mains in the borough, at £5,422. The tender of Messrs. Watson, Gow & Co. was accepted for the supply of 100 tons of 2-inch cast-iron pipes (£5 12s. 6d. per ton) for the electric light mains, and about two tons of special castings (£13 12s. 6d. per ton). The Council also accepted the tender of Mr. R. Fox, Limehouse, E., for copper lining of the condenser tank, the amount of the tender being £54.

Leigh.—The tender of Mr. Bertram Thomas for the addition of two feeder and one dynamo panels to the main switchboard at the Corporation Electricity Works (£259), has been accepted.

Manchester.—The Hart Accumulator Company, Limited, has recently secured the contract from the Guardians of Chorlton Union, Manchester, for renewing a battery of 110 cells, installed at Styal Cottage Homes. It has also obtained an order for the 110-cell battery required at Salford Cottage Homes.

Newport (Mon.).—Messrs. W. T. Glover & Co. have written to the Corporation with reference to their tender for overhead construction for the Council's new electric tramways, which was accepted, subject to the Corporation having the option of extending the contract so that any extensions of the tramway should be dealt with under the same. Messrs. Glover say they are unable to give an open option, as they could not guard themselves against the fluctuations of the market, and the Corporation have decided to waive the clause dealing with the point in question.

Stoke Newington.—The British Thomson-Houston Company, Limited, have secured a contract for the supply of ampere-hour meters, wattmeters and house service cut-outs for the Borough of Stoke Newington.

Swindon.—Some details of accepted tenders appear in our "Traction Notes."

Wakefield.—The West Riding County Council has approved of the acceptance of the tender of the Walsall Electrical Company, of Liverpool, for the installation of the electric light in the new Storthes Hall Asylum, which is in course of erection. The amount of the tender was £5,100, and this was the lowest tender submitted.

Walsall.—The Tramways Committee recommended, and the Council accepted, the following tenders:—

Callender's Cable Company, high-tension cable and tramway feeders.
National Electric Wiring Company, overhead tramway work (sub-contractor for pole, J. Russell & Sons, Limited).
Thomas Parker, Limited, transformers, switchgear, &c., £1,566.
T. Tildesley, tramway transformer sub-station, £899

FORTHCOMING EVENTS.

Friday, January 17th.—At 8 p.m. Institution of Civil Engineers. Students' meeting. Lecture: "The Theory of Heat-Engines," by Captain H. Riall Sankey, R.E. (Ret.), M.Inst.C.E.

Monday, January 20th.—At 3 p.m. Anderton's Hotel, E.C. Meeting of electrical manufacturers and contractors, arranged by the London Electrical Contractors' Association. See "Notes" columns to-day.

Tuesday, January 21st.—At 8 p.m. Institution of Civil Engineers. Ordinary meeting. Paper to be further discussed:—"American Workshop Methods in Steel Construction," by Henry Bridges Molesworth, M.Inst.C.E.

Wednesday, January 22nd.—Institution of Electrical Engineers (Birmingham Section). Paper on "Surface Contact Systems of Electric Traction," by W. Kingsland.

Thursday, January 23rd.—At 8.0 p.m. Institution of Electrical Engineers. Meeting at the Institution of Civil Engineers, Great George Street, Westminster. Paper on "Earth Currents Derived from Distributing Systems," by E. B. Wedmore.

Instead of January 16th. At 7.30 p.m. Institution of Electrical Engineers (Dublin Section) will meet at the Royal College of Science, Stephen's Green. Paper: "Notes on Inductive Circuits," by W. Brew.

Saturday, January 25th.—At 6.30 for 7 p.m. Institution of Junior Engineers. Seventeenth anniversary dinner at the Hotel Cecil, the president, Sir John Jackson, F.R.S.E., in the chair.

At 10.0 a.m. Institution of Electrical Engineers (Students' Section). Visit to the works of the India-Rubber, Gutta-Percha and Telegraph Works Company, Limited, Silvertown.

THE CRAWFORD-VOELKER LAMP.

We have pleasure in announcing that the proprietor of the Crawford-Voelker patents has consented to provide us with a quantity of these lamps, in accordance with our proposal, for the purpose of making a thorough test of their life and efficiency. Full particulars of the arrangements for carrying out the tests, and of the results obtained, will be published in our columns upon their completion. In the meantime, we propose to refrain from further comment on previous tests, &c. We hardly need add, that if the tests confirm the qualities claimed for these lamps, we shall be among the first to congratulate both the inventors and the electrical industry in general upon a decided step in advance.

December 20th.

"Official Notices" January 3rd.

NOTES.

Parliamentary.—On Saturday next, January 18th, the Examiner will sit to see if Standing Orders have been complied with with respect to the private Bills for Session 1902. Thirty-five Bills are ordered to be taken at the first sitting, and they include the Cornwall Electric Power Bill, the North-West London Railway, the Bradford Corporation Bill, Leicester Corporation, Newcastle-on-Tyne Corporation Tramways Extension, London County Council (Tramways and Improvements), Preston Corporation, Brompton and Piccadilly Circus Railway (new lines and extensions), Northumberland Electric Tramways (Morpeth to Bedlington, Bebside to Blyth, and Ashington to Newbiggin), the London and Brighton Electric Railway, Manchester Corporation, Charing Cross, Euston and Hampstead Railway (No. 3), City and North-East Suburban Railway (No. 2), Birkenhead Railway, and Donegal Railway

Of these, memorials have been presented alleging non-compliance with standing orders, against the following:—London County Council (Tramways), by the Borough Council of Wandsworth; Northumberland Electric Tramways, by Richard Guy Lindsay; the London and Brighton Electric Railway, by the London and South-Western Railway, the South-Eastern Railway, the London, Brighton and South Coast Railway, W. Davies and others, Charles Spencer and others; Frank Appleby and others; and Henrietta Monteforre and others; the Birkenhead Corporation Bill, by Edwin Milnes and others.

Memorials have also been received alleging non-compliance with standing orders in respect of the following Bills:—South Shields, Sunderland and District Tramways, by the Corporation of South Shields; the London United Electric Railways, by R. J. Walker; the North Ormesby, South Bank and Grangetown Tramways, by the Imperial Tramways Company; Torquay and Paignton Tramways, by the Corporation of Torquay; the Croydon and District Electric Tramways, by the Croydon Corporation, the Croydon Rural District Council, the London County Council and the Urban District Council of Beckenham; Scarborough Tramways, by the Corporation of Scarborough; the Tyneside Tramways and Tramroads Company (new lines and extensions), by S. Whittlestone and C. H. Billing; the London United Tramways, by the London County Council, the Urban District Council of Wimbledon, the Chelsea Waterworks Company, the Corporation of Richmond, the Urban District Council of Barnes, and the Croydon Rural District Council; the Saddleworth, Springhead and Lees Tramways, by the Urban District Council of Lees.

Electrical Standardising, Testing and Training Institution.—As the result of the recent scholarship examination, the Board of Control of this Institution have made the following awards:—

To Alfred Thomas Morris, of Bedford Modern School, a Maxwell Scholarship, value 50 guineas, tenable for two years.
To William Leighton Chubb, of Dunheved College, Launceston, an Exhibition, value 30 guineas, tenable for two years.
To Alban Cecil Whish, of Hillmartin College, an Exhibition, value 20 guineas, tenable for two years.
To Herbert William Swann, a Special Prize of 15 guineas.
To Eustac Blackburne Ritsen, of Shrewsbury Public School, a Special Prize of 10 guineas.

High Speed Engines. — Mr. Dale's second article in *Foilden's Magazine* deals almost wholly with what may be termed the line of parts, especially in reference to their strength in resisting inertia forces. He specially enforces uniformity of strength throughout, and the reduction of section of bolts below the core diameters of the threaded end, either by turning down the bolt, or by drilling it from the head end, if it must be parallel externally. He calculates the strength of parts by the familiar rule of centrifugal force = 0·00034 w r N^2, where w is the weight, r the radius of the crank in inches, and N the revolutions per minute, and he takes the limit of elasticity, very properly, as the basis of resilience of the material, and shows that high revolution engines are, or easily can be, safe. The article is somewhat involved, curiously punctuated, and marred by incorrect prepositions and ambiguities.

The Breakage of Shafts at Critical Speeds.—The discussion on the paper by Messrs. Lamb and Frith, to which we referred in our January 3rd issue, did not evoke a discussion very much to the point. Mr. M. Longridge referred to the oscillations of the old-fashioned long-spring steam engine indicators, and said that no one ever thought of calculating these, though, of course, they were so obviously due to inertia, and not to pulsation of the steam, and he drew a comparison favourable to present practice, which calculated the more occult vibrations in a crankshaft. While he thought that fractures of crankshafts were very probably traceable sometimes to the causes indicated, he wished to point out the serious fault committed by some high-speed engine makers in actually cutting screw threads on dynamo shafts. He had known such a shaft to break at the thread of a little oiling ring. Dr. Hopkinson thought that possibly the groaning of armatures at certain speeds might be traced to some such cause as dealt with in the paper. Mr. Earle, observing that the effects discussed could not occur in absolutely rigid shafts, thought it satisfactory to know that the trouble could be removed by slightly varying the shaft diameter; but he asked what of the oscillation by which armatures got loose on their keys. Mr. Lange observed that the subject pointed to the necessity of perfect balancing of turning effort, but we fail to see that this would have much effect, and it was not clear if turning effort or mass balance was intended. Another speaker supported him, and appeared to refer to balance of revolving masses. There are few parts of machinery where material is worse placed to withstand stress than in the form of a revolving shaft. Much of the shaft has so slow a movement, that its power to do work is very small. Hence the very slight loss of even theoretical strength by boring out the centre of a shaft. Then a shaft has to act as a beam against bending stresses, and a round beam is a badly designed structure. The length of a shaft exposed to torsion allows quite a wide angular displacement to occur, and long shafts are to be calculated on grounds of stiffness. For a shaft to carry load as a beam, it must be of large diameter. If large, it introduces bearing friction. Hence the importance of keeping shafts as short as possible when loaded, so that they may not bend. Such a shaft needs to be of approximately parabolic form in order to reduce the middle deflection. A case has been known where two rope pulleys side by side on a shaft have touched each other above and have been quite separated below owing to bending. One of the best designs of engine to overcome shaft troubles is the straight line engine of Prof. John Sweet, who simply used two fly-wheels and joined them by a short stiff crankpin. There was a crankshaft, but it carried no torsive stress. The system was only applicable to a special class of engine. A difficulty with crankshafts is that one cannot place them in a position of maximum stress and hold them there. Could this be done they would never oscillate, for the maximum stress would not move them beyond the fixed position. The bolts in a cylinder cover do not break from oscillatory stress, because they are first screwed up beyond the maximum stress due to steam pressure, and when the steam pressure is admitted to the cylinder it has no effect whatever on the bolts. Its only effect is to reduce the pressure between the cylinder cover and cylinder end. Similarly with a bridge. This may be loaded with a maximum load and anchored down to its maximum deflection. It is then safe against impact stresses, and many a weak bridge might be made safe could it only be anchored down to the extent of its maximum deflection to the rocks below. The fortuitous coincidence of the period of vibration of a bridge with the time of passage of a locomotive and the effect of the unbalanced action of the wheels has been observed to have bad effects, especially where the wheel circumference has coincided with the panel length of the bridge. In course of years these fortuitous coincidences happen in all kinds of machinery, and are probably a contributing reason to the greater solidity of the structures of an old established industry than of a mushroom industry that has not been going long enough to have experienced a sufficient number of convincing failures. The gradual increase of weight and sections in American constructional work generally bears out this suggestion.

Personal.—Early in December Sir Charles Todd, Deputy-Postmaster-General, completed sixty years of continuous work in the Imperial and South Australian services, fourteen years having been spent in the Greenwich and Cambridge Observatories and the remainder in South Australia. The heads of the various departments in connection with the Post and Telegraph service met to congratulate Sir Charles upon his long and distinguished career. His Excellency the Governor Lord Tennyson sent the following message:—"My heartiest congratulations on your sixtieth official birthday." The following cablegram was received by Sir Charles Todd from the London manager of the Eastern Extension Telegraph Company:—"Chairman of the Board and executive officials offer you their heartiest congratulations on your completion of sixty years' service in the cause of science and progress, and trust you may long be spared to continue your useful labours."

Mr. W. H. Flood, who has been in charge of the electrical engineering department of the Thames Ironworks, Shipbuilding and Engineering Company, Limited, for the past year, has now been formally appointed manager by the directors.

Mr. F. R. Thackrah has resigned the position of head draughtsman to Messrs. Laurence, Scott & Company. The staff presented him with a solid silver cigar case and a cigarette case.

Mr. A. G. Bayfield has vacated the post of manager to Messrs. A. E. Bennett & Co., of Streatham, and Mr. S. O. Hoad has been appointed in his place.

Lectures.—Three courses of lectures on railway subjects are to be delivered at the London School of Economics and Political Science (University of London). One of the courses of six lectures is to be delivered by Mr. Lynden Macassey, B.A., L.L.B., on Mondays at 6.15 p.m., beginning February 10th, on "Electric Traction on Railways." The lecturer will show the necessity, in many cases, for improvement in motive power on railways; the peculiar advantages of and economy resulting from electric traction, and conditions most favourable for its adoption; the various systems of electric traction, their individual advantages and limitations; the extent to which electric traction has been adopted on the railways of the world, and, so far as is possible to ascertain, the results obtained thereby.

Professor S. A. Fleming gave the sixth and last of his Royal Institution Christmas lectures on "Waves and Ripples" on 9th inst., when he dealt with electric waves in the ether.

At a meeting of the Institute of Civil Engineers (Ireland), in Dublin, on Wednesday last week, an interesting paper on "Supply of Electrical Energy in Cities" was read by Mr. Mark Ruddle. The paper concluded with a sketch of the installation at present being laid down in Dublin.

Tramway Plant for Sale.—The Bristol Tramways and Carriage Company are offering for sale as a whole the complete electrical and other plant employed at their St. George suburban power station, which they are now closing down, as the new central power station is completed.

Mr. R. Fox, Limehouse, E., for copper lining of the condenser tank, the amount of the tender being £54.

first to congratulate both the inventors and the electrical industry in general upon a decided step in advance.

Liverpool Laboratory for Electrotechnics.—Principal A. W. W. Dale, of University College, Liverpool, has made a public appeal, on behalf of the Council of the College, for funds with which to build a new laboratory for the electrotechnics department, "now housed in premises that are inconvenient and inadequate." Until the end of the session 1899—1900, electrotechnics were included at University College, Liverpool, in the department of physics, under the direction of Dr. Oliver Lodge, now principal of the Birmingham University. On Dr. Lodge's removal, and by his advice, an independent lectureship was established, which was assigned to Dr. Alfred Hay, now Professor at the Royal Engineering College, Cooper's Hill. Dr. Hay was succeeded by Dr. E. W. Marchant. The department, Dr. Dale says, has outgrown its accommodation, and its work is carried on under drawbacks of every kind. The Council are anxious to provide for electrotechnics. The cost of a laboratory sufficient for immediate needs, and allowing for future developments, should not, Principal Dale states, exceed £10,000. He asks if some friend of education, some man of wealth and wisdom, will do for electrotechnics what Mr. W. P. Hartley had just done for botany, the Rev. S. A. Thompson-Yates for physiology, and what Sir Andrew Walker, in earlier days, did for engineering. "It is a practical need; it should appeal to the sympathy of practical men," says Principal Dale, in bringing his own appeal to a close.

Technical Periodicals.—In a recent address before the Society of Mechanical Engineers, at Sibley College, Cornell University, Prof. H. Wade Hibbard made the following pertinent remarks concerning the engineering press, which we quote from a Chicago exchange:—"Among the most valuable members of the engineering profession to-day are the moving spirits of the engineering press. Much matter of great value is regularly to be found in the current periodicals of a profession growing so rapidly and in so many directions as is mechanical engineering. Books, monographs upon particular subjects, necessary as they are by their gathering within one cover all the required material of years and many places, and by their orderly classification, logical discussion, and evolving of principles, are, by very necessity of their production, always and inevitably behind the times. The reason for existence of the engineering press is to collect all recent valuable information—news, if you please—and present it weekly or monthly, less or more digested, to as large a circle of readers as possible. The American papers, representing special branches of the profession, far surpass in numbers and variety and excellence the like papers of the old world. Their general use proves that they have a most important place. With these may be grouped the published transactions of the many engineering societies and clubs. Unthinkingly or deliberately to neglect forming acquaintance with so great a source of engineering knowledge is not fitting for the student who has his own future to make in a country where ruts and old fashions are only for the failures."

Institution of Electrical Engineers (Newcastle).—On Monday, 13th inst., Mr. A. Gott read a paper on "Starting Resistances." Mr. J. W. Turner has resigned the position of acting secretary to this section of the Institution.

Overhead Wires.—An application made last week by a Mr. Cooper to the Highways Committee of the Lichfield Corporation, for leave to run wires across a street for electric lighting purposes on the occasion of a dramatic performance, was refused on the ground that the Electric Lighting Clauses Act, 1899, provides that the express consent of the Board of Trade must be obtained to carry wires overhead! This is a bright example of local government. Seeing that Mr. Cooper had no provisional order, what had the Clauses Act to do with him? Municipalities clamour for the control of their streets, but apparently this one has not troubled to ascertain the nature and extent of its powers. Mr. Cooper would have been well advised in running the wires across, at the proper height, and saying nothing at all about the matter.

National Electrical Contractors' Association.—A general meeting, under the auspices of the National Electrical Contractors' Association, is to be held at Anderton's Hotel, Fleet Street, E.C., on the evening of Monday, 20th inst., at 7 o'clock, when reports will be submitted, and questions of trade interest discussed. Electrical contractors in London and the provinces are urgently requested to attend this meeting. Mr. T. Guthrie, of 46, Queen Victoria Street, E.C., is hon. secretary.

Advice to the Public.—The Town Clerk of Dudley has issued a set of hints for the guidance of the police and the public in reference to accidents and danger from electric tramway wires. On the facing page of the circular letter which gives these hints we note with interest that the Electrical Review's suggestions for dealing with apparent death from electric shock, which are pretty familiar to every station engineer in the kingdom, are reprinted also for the information of the public in cases of emergency.

Electric Clocks.—The Glasgow Public Clocks Committee have decided to try an experimental circuit of five of Prof. Becker's (of Glasgow University) new electrically-controlled timepieces in the north-western district of the city.

Tale of a Dog.—A provincial correspondent sends us the following:—"In Church Street, St. Helens, on Monday night last week, the Haydock St. Helens Junction and Parr trams were stopped for half an hour on account of a collie dog, which was caught under one of the Haydock cars and became entangled among the wheels and springs. The utmost consideration was shown for the poor brute, the officials stopping the car and obtaining the advice of a veterinary surgeon who attempted, but ineffectually, to kill the dog with a hatchet. A dose of poison also failed, and after great delay and inconvenience the animal was extricated. It hopped away for some distance, and was then taken to the public abattoir and slaughtered."

Not Caused by Lightning.—An inquiry was held at Chatham on the 10th inst. by Mr. Alfred Hands, F.R.Met.Soc. in reference to a claim by the Churchwarden of Holy Trinity Church, New Brompton, Kent, against the Insurance Company for damage alleged to have been caused to the spire of that church by lightning on some date unknown. Some stones having fallen in July last, an examination of the spire was made, and cracks being found of such a nature as to render immediate repairs necessary, the work was carried out and compensation was claimed under the fire policy, which, as usual, contained a clause including lightning risks. The insurance company having disputed the claim, Mr. Hands was appointed Arbitrator, and after hearing expert evidence on both sides and examining the damaged stones, which had been preserved for the purpose of the inquiry, he decided that the damage was not caused by lightning, but was due entirely to the rusting of the vane rod, which passed through the stones, and, therefore, that the company was not liable.

The City Explosions.—On Wednesday, Mr. A. P. Trotter opened a Board of Trade inquiry at the Guildhall in regard to the explosions which occurred in electric mains in the City on January 4th and 5th. Police evidence as to the accidents was first given, and a statement was made by Mr. Patchell representing the Charing Cross and Strand Company. Mr. Frank Bailey, of the City Company; Mr. Buck, mains superintendent to the same company; and Mr. C. H. Wordingham, also gave evidence, after which the inquiry closed. Our report of the proceedings will be published next week, and we refrain from commenting upon the mishaps until the issuance of the Board of Trade report.

The German Cable Industry.—In Mr. O'Gorman's highly instructive and practical notes, published on another page, one of the reasons given for future competition with British cable makers appears to be open to question. If German manufacturers introduce extra high pressure cables into this country, they must comply with exactly the same Board of Trade regulations as our own firms; while, if the process is inverted, our cable makers, exporting cables to other countries, will be equally free from these oppressive restrictions.

London Electrical Contractors' Association.—A meeting of manufacturers and contractors is being arranged by the Association for Monday next, January 20th, at 3 p.m., at Anderton's Hotel, Fleet Street, E.C., when it is hoped to form an Association of Electrical Manufacturers, who would confer with the Committee of the L.E.C.A. upon matters of vital importance to the electrical profession. The first annual dinner of this Association is to be held in the Grand Hall, Hotel Cecil, in February. Mr. E. J. Hogan, of 141, Fenchurch Street, E.C., is secretary of the Association.

The Manhattan Railway.—The first train was run on this elevated railway on 9th inst.

Glasgow Tramways.—The Corporation have approved of the tramways department fixing red-coloured lamps at the ½d. stage stopping places, and green-coloured lamps at stopping places where cars stop when requested by passengers getting on or off.

Finsen Light.—An anonymous donor has offered a set of Finsen light apparatus to the Dundee Royal Infirmary, and the offer has been gratefully accepted.

Institution of Junior Engineers.—A large number of members of this Institution visited the extensive and up-to-date factories of the Mazawattee Tea Company at New Cross, on January 9th. Electric driving and lighting are employed, the steam engines, &c, supplying the power, totalling about 1,000 horse. The ensuing meeting takes place at the Westminster Palace Hotel on Friday, February 7th, when a paper is to be read by Mr. W. J. Cooper on "The Electric Passenger Elevator."

Appointments Vacant.—The Wolverhampton Corporation are about to appoint a general traffic manager of the new electric tramways, at a salary of £250 per annum. An electrical engineer is wanted for Bray electricity works, at £150 per annum. A works superintendent, at £110 to £155, is wanted for Barrow-in-Furness electricity department. Two junior assistants are wanted at the Newcastle-on-Tyne Electric Supply Company's Tyneside power station. Switchboard attendants are wanted at Mexborough and Devonport.

THE CENTRAL STATION ENGINEER.

Personal.—For the post of assistant engineer vacated by Mr. E. H. Wright at the Oldham electricity station, Mr. L. L. Ogden, engineer-in-general at Harrogate, has been selected out of a large number of applicants.

Mr. A. S. Channon, of Barrow-in-Furness, has been appointed to the position of chief assistant engineer to the Grimsby Corporation electricity department. 107 applications were received for the

appeared to refer to balance of revolving masses. There are few

power station is completed.

position. The other two selected candidates were Mr. G. STAMP TAYLOR, of Leeds, and Mr. G. S. SHANKSTER, of Grimsby.

Mr. F. E. SHARPE, of Newcastle, has been appointed to the post of draughtsman to the Brighton Corporation.

The salary of Mr. HUBERT POOLEY, manager of the Stafford Corporation electricity and gas works, has been, in accordance with the terms of his engagement, increased by the Town Council to £400.

In succession to Mr. DRYSBOROUGH, who has obtained an appointment at Swansea, the Grimsby Corporation has appointed Mr. A. S. CHANNON, of Barrow-in-Furness, as assistant electrical engineer.

Mr. W. E. J. HEENAN, of Northampton, has been appointed electrical engineer to the Southend Corporation at £350.

NEW COMPANIES REGISTERED.

National Rail and Tramway Appliances Company, Limited (72,375).—This company was registered on January 4th, with a capital of £1,000 in £5 shares, to adopt an agreement with Phelam McCullough, to acquire certain inventions relating to appliances and fittings for railways, tramways, motors and vehicles, or to the production, storage and use of electricity or other motive power, and to turn the same to account. The first subscribers (each with one share) are:—A. H. Rigmaiden, "Mansergh," The Parade, Hoylake, merchant; James Owens, The Hollies, Liscard Road, Egremont, merchant; John Owens, The Hollies, Liscard Road, Egremont, shipowner; R. Owens, The Hollies, Liscard Road, Egremont, shipowner; J. W. Black, Ferndale, Island Road, Garston, manager; D. R. Burdley, Newsham Park, Liverpool, coal and coke merchant; T. Ashmore, Rock Cottage, 513, West Derby Road, Liverpool, engineer and ironfounder; and P. McCullough, 19, Osborne Road, The Brook, Liverpool, electrical engineer. No initial public issue. The number of directors is not to be less than three nor more than five; the first are A. H. Rigmaiden, James Owens and T. Ashmore.

Ito Syndicate, Limited (72,421).—This company was registered on January 9th, with a capital of £45,250 in 45 "A" shares of £1,000 each, and 250 "B" shares of £1 each, to acquire the benefit of certain Acts of Parliament, provisional orders and applications for provisional orders, to promote any Act of Parliament, to make application to the Light Railway Commissioners, the Board of Trade, or other authorities for any powers for the construction of various tramways, light railways, and other works, to construct, equip, maintain, work and control any tramways, railways or light railways, to sell, re-sell or otherwise dispose of the same, and to carry on the business of company promoters, financiers, financial agents, underwriters, merchants, contractors, &c. The first subscribers (each with one share) are:—F. P. Timmins, 118, Crofton Road, Camberwell, clerk; J. H. Chamberlain, 44, Wiverton Road, Sydenham, gentleman; G. D. Dean, 23, Cleveland Road, Barnes, S.W., solicitor; W. Willis, 101, Tyneham Road, Lavender Hill, S.W., clerk; Miss A. Hesketh, 6, Sandown Road, Charlton, S.E.; A. Peckover, 69, Trinity Street, S.E., clerk; R. Humphreys, 28, Wetherell Road, South Hackney, N.E., assistant cashier. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, one share. Registered office, 14, Queen Victoria Street, E.C.

Schäffer & Budenberg, Limited (72,396).—This company was registered on January 7th with a capital of £50,000 in £10 shares to acquire and carry on the business of engineers, makers of pressure gauges, engine and boiler fittings, indicators and measuring instruments, brass finishers, general hardware merchants, &c., now carried on under the style of Schäffer and Budenberg, at Whitworth Street, Manchester, 77A, Queen Victoria Street, E.C., and 5, Wellington Street, Glasgow, and to carry on the business of mechanical, electrical, consulting and general engineers, founders, smiths, machinery and tool makers, manufacturers of instruments and implements, makers of rolling stock, dealers in hardware, &c. The first subscribers (each with one share) are: H. O. Arnold, Schonebecker Strasse 11—13, Magdeburg, Ruckau, Germany, engineer; F. W. Dresel, Hohenbellin bei Genthin, Germany, engineer; E. J. P. Schäffer, Siegmundshof 10, Berlin, N.W., Germany, engineer; Mrs. M. S. Rudolph, Kaiser Wilhelmstrasse 10, Magdeburg, Germany; C. F. Budenberg, Somerville, Marple, Cheshire, engineer; R. M. Chiswell, 87, Withington Road, Whalley Range, Manchester, cashier; and J. A. Bland, 27, Brazennose Street, Manchester, solicitor. No initial public issue. The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first; remuneration as fixed by the company. Registered office, 31, Whitworth Street, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Western Telegraph Company, Limited (6,886).—Particulars of registered mortgages and charges:—Date of trust deed, June 20th, 1900; total amount of debenture stock, £400,000; date of resolution creating debenture stock, May 23rd, 1900; property charged—All the undertaking and property of the company, present and future; trustees—The Right Hon. W. St. John F. Brodrick, M.P., 34, Portland Place, London, and Sir John W. Barry, K.C.B., 23, Delahay Street, Westminster; date of present issue, July 30th, 1901; amount of present issue, £50,00; total amount previously issued of same series, £334,577.

Pacific and European Telegraph Company, Limited (36,683).—This company's annual return was filed on December 21st, when the entire capital of £100,000 in £10 shares had been taken up. £4 per share has been called up, resulting in the receipt of £40,000. Mortgages and charges £100,000.

Bullers, Limited (62,020)—This company's annual return was filed on December 14th, when 15,000 ordinary and 15,000 preference shares were taken up out of a nominal capital of £400,000, divided into 20,000 ordinary and 20,000 preference shares of £10 each. £10 per share has been called up on seven ordinary and 15,000 preference shares, resulting in the receipt of £150,070. £149,930 is considered as paid. No mortgages or charges.

Monte Video Telephone Company, Limited (72,208).—This company's annual return was filed on November 21st, when 86,492 preference and 72,680 ordinary shares were taken up out of a nominal capital of £160,000 in 87,000 preference and 73,000 ordinary shares of £1 each. £159,172 shares considered as fully paid. Mortgages and charges—Nil.

Adams-Randall Telephone Patents Company, Limited (61,457).—Particulars of registered mortgages and charges:—Date of covering deed, April 22nd, 1899; total amount secured by series of debentures, £10,000; date of resolution creating series of debentures, April 22nd 1899. Dates and amounts of issues made in 1901, with names and addresses of mortgagees—May 24th, £250, the Columbus Company, Limited, 43 and 43A, Fetter Lane, E.C.; July 9th, £350, London and Foreign Contract Corporation, Limited, 65, New Broad Street, E.C.; September 30th, £100, H. E. S. Holt, 1, St. James Street, S.W.; December 30th, £300, London and Foreign Contract Corporation, Limited. Property charged—All the property of the company; trustee, F. Davies, 95—7, Finsbury Pavement, E.C.; total amount previously issued of the same series, £8,200.

CITY NOTES.

Typewriting Telegraph Corporation.

AN adjourned meeting of the shareholders of the above company was held at Winchester House, E.C., on 9th inst., to receive the report of the committee of investigation appointed to inquire into the affairs of the company. Sir James Ferguson, M.P. (chairman of the company), presided.

Mr. PARKER (chairman of the shareholders' committee) read the committee's report and moved its adoption, this being seconded by Mr. KNIGHT.

The CHAIRMAN replied on the committee's report paragraph by paragraph, and said that as the report was only submitted on Monday the board had been unable to circularise any reply. He denied that it was due to any want of ability on the part of the board that they were unable to obtain a supply of instruments. The statement regarding the order for the 530 receivers was misleading. What the board did was to order these instruments with the proviso that they must be made according to the sealed pattern of the Post Office. There were, however, many parts which could be proceeded with, and the final order was not given until the day after the Post Office approved the pattern. Notwithstanding the efforts of the board they were unable to get the instruments delivered. It was impossible for the board to give the order until they heard from the Post Office. Although it was true the manager was not able to come to the office, yet his son was in attendance, and the secretary was constantly in communication with the manager. They could not blame the board for not showing the instrument until it was approved by the Post Office. The failure to deliver machines to Mr. Liebmann was no fault of the directors, and it was impossible to have a penalty clause in the makers' contract until the Post Office had approved of the instrument. They did not consider the policy of selling foreign patents outright for cash unwise. As a matter of fact, in the three cases in which this was done they were obliged to do so, as Mr. Liebmann had the option. In all other cases cash and shares were taken. The phonophone was in no way antagonistic to their instrument. If the contracts referred to were those referred to in the prospectus, they were bound to take them over. He knew no reason for the statement made that the results obtained at Glasgow and Newcastle were not made public. As a matter of fact, Mr. Goulding delivered a lecture before the Institution of Mechanical Engineers and referred to the success obtained; the instruments were shown before the Institution of Electrical Engineers, and their success was largely referred to in the Press. Thousands of pamphlets on the subject were issued. With regard to the Exchange Company, the agreement not to compete with news was taken over from their predecessors. In conclusion, he charged the committee with acting on preconceived opinions, and with taking no account of the difficulties which the board had had to meet.

Mr. KING, representing the Exchange Telegraph Company on the board, denied that the Exchange Telegraph Company had done anything antagonistic to the company, and said if any attempt was made to upset the rights of the Exchange Company, it would lead to a legal fight.

Mr. PARKER reiterated the opinion that the contracts with the Exchange Company were unfair to the company.

The CHAIRMAN pointed out that the contracts were taken over.

Mr. PARKER said he did not say they were of the directors' making. He contended that the report of the committee was made without fear or favour.

After considerable discussion, the motion for the adoption of the committee's report was carried.

A poll was demanded, and the meeting was adjourned till January 23rd, at 3 o'clock, for the purpose of taking the poll.

City and South London Railway Company.

THE accounts for the half-year ended December 31st, 1901, show a balance, after providing for the debenture stock interest, transfer to the renewal fund of £2,000, and the full dividend of 5 per cent. per annum on the preference stocks, sufficient to allow the payment of a dividend on the consolidated ordinary stock for the half-year and on the ordinary shares from November 17th last at the rate of 2¼ per cent. per annum, carrying forward a balance of £1,424. The dividend for the corresponding period last year was at the rate of 1¼ per cent. per annum, carrying forward a balance of £1,228.

Stock Exchange Notices.—The Committee have appointed a special settling day as under:—Wednesday, January 22nd—Calcutta Electric Supply Corporation, Limited, further issue of 10,000 shares of £5 each (issued at £1 per share premium), £2 paid (£1 capital and £1 premium), Nos. 30,001 to 40,000; Central Electric Supply Company, Limited, £250,000 4 per cent. guaranteed debenture stock. Applications have been made to the committee to appoint a special settling day in and grant a quotation to—British Electric Traction Company, Limited—Further issue of 37,926

Ordinary shares of £10 each fully paid, Nos. 122,075 to 160,000, and 10,000 6 per cent. Cumulative Preference shares of £10 each fully paid, Nos. 190,001 to 200,000; and to allow the following securities to be quoted in the Official List:—Commercial Cable Company, further issue of £100,180 sterling 500-year 4 per cent. Debenture stock (redeemable).

Direct United States Cable Company.—The board have resolved upon the payment of an interim dividend of 3s. per share, free of income-tax, being at the rate of 3 per cent. per annum, for the quarter ending December 31st, 1901, such dividend to be payable on and after the 31st inst., setting aside £10,000 to reserve fund account, and carrying forward a balance of about £3,350.

Edmundson's Electricity Corporation.—The directors have declared an interim dividend on ordinary shares of 5 per cent. per annum for the half-year ending September 30th, 1901, and dividends will be paid on 17th inst.

Globe Telegraph and Trust.—The directors announce a quarterly dividend of 1s. 9d. per share on the ordinary shares.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Jan. 10th were £606; corresponding week last year, £507; increase, £99. Total to date, £948; corresponding period last year, £806; increase £142. Miles of track open, 10¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending January 11th were £144; corresponding week last year, £142; increase £2. Total receipts to date, £268; corresponding period last year, £283; decrease, £15.

Bristol Tramways and Carriage Company.—The receipts for the week ending January 10th were £4,023; corresponding period last year, £3,386; increase, £637.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending January 3rd:—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. — £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. — £
Croydon*	580	341	—	53	18,611	3,145	—
Devonport ..	295	—	—	28	11,067	—	—
Dudley—Stourbridge	599	107	—	53	34,641	16,162	—
Gateshead ..	711	—	—	44½	20,508	—	—
Greenock-Pt. Glasgow	461	—	—	13	3,989	—	—
Hartlepool	225	43	—	53	11,805	1,184	—
Kidderminster ..	93	10	—	53	6,331	196	—
Merthyr	189	—	—	49	9,564	—	—
Oldham—Ashton ..	490	27	—	53	26,168	3,089	—
Poole	172	—	—	39	10,630	—	—
Potteries	1,399	170	—	53	74,211	20,166	—
Southport†	134	8	—	53	8,408	—	2,784
South Staffordshire‡	785	54	—	53	40,958	2,497	—
Swansea	488	55	—	53	28,345	4,371	—
Taunton	67	—	—	19½	1,508	—	—
Tynemouth	215	—	—	41	10,898	—	—
Wolverhampton Dist.	78	32	—	53	3,541	842	—

* Partly horse. † Reconstructing. ‡ Partly steam.

Central London Railway.—The receipts for the week ending Jan. 11th were £6,664; corresponding week last year, £5,676; increase, £988. Total receipts to date, £12,772; corresponding period last year, £11,523; increase, £1,249. Miles open, 6.

City and South London Railway.—The receipts for the week ending Jan. 12th were £3,084; corresponding week last year, £2,047; increase, £987. Total recipts to date (2 weeks), £6,210; corresponding period last year, £4,071; increase, £2,139. Miles open, 6½; corresponding period last year, 4½.

Dover Corporation Tramways.—The receipts for the week ending January 11th were £179 19s. 6d.; corresponding week last year, £153 11s. 1½d; increase, £26 8s. 5d. Total to date, £312 16s. 6d.; corresponding period last year, £201 12s. 11½d.; increase, £12 3s. 7d. Miles of track open, 3. Car miles run, 1902, 5,072; 1901, 4,869. Number of cars, 1902, 12; 1901, 11.

Dublin United Tramways Company.—The receipts for the week ending January 10th were as follows:—D.U.T. Co., electric cars, £3,617 15s. 11d.; D.S.D. Co., electric cars, £726 13s. 0d.; total, £4,344 8s. 11d.; corresponding week last year—D.U.T. Co., electric cars, £3,222 12s. 8d.; ditto, horse cars, £18 19s. 1d.; D.S.D. Co., electric cars, £651 8s. 3d.: total, £3,893 0s. 0d.; increase, £451 8s. 11d.; aggregate to date, £6,278 7s. 5d.; aggregate to date last year, £5,738 1s. 3d.; increase, £540 6s. 2d. The mileage worked is 45 miles electrically, as against 43 miles electrically, and 2 miles by horses for the corresponding period last year.

Glasgow Corporation Tramways.—Week ending January 11th, £10,669 7s. 7d.; £8,525 3s. 3d. for corresponding period last year. Aggregate receipts since commencement of financial year (June 1st, 1901), £392,859 16s. 1d., compared with £303,143 2s. 1d.

Liverpool Overhead Railway.—The receipts for the week ending January 12th were £1,453; corresponding week last year, £1,512; decrease, £59. Total from January 1st to date, £2,855; total for corresponding period, 1901, £3,055; decrease, £200. Miles open, 6 miles 67 chains.

STOCKS AND SHARES.

Wednesday Evening.

THE Money Market, after hardening its rates a little out of consideration to the Stock Exchange Settlement, is inclined to ease off again now that large dividend payments are being made. The higher charge for money in the early part of the week affected Stock Exchange securities but little. Business is too active for brokers to bother about a half per cent. more or less on their fortnightly loans. The Kaffir tide continues in full flood, and the City of London Electric Lighting Company should bless the boom which keeps Stock Exchange staffs at their offices far into the night, as they work beneath the electric lamps. Business, however, is still pretty general, the Yankee market being the only really neglected spot, and in electric lighting shares more trade has been done in the account just closing than there has been in any one fortnight since the last electric "boom" some years ago. Yet, as illustrating the level proportion maintained by buyers and sellers, it is worth noticing that there are but four variations in the whole price list, and each of those is comparatively slight.

To particularise, Chelsea Electric Ordinary have recovered their relapse of 10s. last week, the sales having ceased. City of London are easier at £9, dividend anticipations being less sanguine than they were, but London Electric Debentures and Edmundson's Debentures are up a point. The Debenture Department is particularly strong, and it is difficult to find any reasonably priced stock at anything like a moderate quotation. Brush Second Debenture is, however, a weak feature, having shed 2 per cent. Westminster fractions are quoted at 1s. 3d. to 1s. 9d. premium, the full shares at £1 premium. The last day for applying for the latter has now passed. First among the interesting Home Railway dividends, the City and South London's announcement at the rate of 2¼ per cent. per annum is of cheerful augury to that most distressful section, the Home Railway market. This compares with 1¼ per cent. a year ago, and is decidedly better than the most hopeful of us were anticipating. It brings up the whole year's dividend to 2 per cent., so that at the current price of 66, the return to an investor is just about 3 per cent. on his money. The Stock has risen as many points this week, and the poverty of the return upon one's outlay is considered justified by the prospects of the company. Waterloo and City is unchanged, and the Central London Stocks are also without alteration. Great Northern and City "A" Shares are a little lower at 8⅜. We may remark that small parcels of shares are being put into the names of Continental buyers. Metropolitan Ordinary is dull at 76 and District keeps a point or two under 30.

We have taken occasion several times during the last few months to suggest that British Electric Traction shares were not an attractive purchase so long as the "option" line held by Messrs. J. S. Morgan & Co. was hanging over the market. It may now be observed that this danger has been shelved for some time to come, and from what we can see, British Electric Tractions are not unlikely to enjoy a steady advance in the near future. The price of the shares is up 10s. this week, to 14½. Potteries are 11½, 10½ and 107½ for the Ordinary, Preference and Debentures respectively, while the prices of Dublin United, in the same order, are 12, 15½ and 98½. New General Electric Tractions are dull at 3, the Preference being 4½. The friction between Argentina and Chili being still in evidence, Anglo-Argentine Trams are not better than 3¾; Cape Electric Tramways stay at 2, the market not relishing the restrictions put upon immigration, while the new issue of 40,000 shares at 1⅞ naturally keeps the price down. Calcutta Trams are 13. Some inquiries for Bordeaux Tramways shares have found the price to be 7 to 8, but sellers predominate, and a broker has a hard task in finding buyers. Buenos Ayres and Belgrano descriptions are firm, the Ordinary being 1⅞, the "A" and "B" Preferences both about 5⅜, and the first Debenture stock 104½.

There is but little improvement to report in the telegraph market, while in several cases the slump is making further progress. In the American group Anglo "A" and "B" are both better, the latter having regained a couple of points, and Direct United States shares are up 10s., the dividend and carry-forward being considered very satisfactory. Contrariwise, to quote Tweedledee, Submarines are 2½ down. In the other divisions, Easterns and "Chinas" are nominally unchanged, but Eastern Extension 4 per cent. Debenture has lost another 3 points, the while a similar stock of the sister company has added one, bringing the two securities very close as regards price. West India and Panama shares are shaking off some of their recent flatness, but the Debentures are dull. Indo-Europeans are 2 down, and Commercial Cable Debenture stock has shaded off to the same extent. The latter looks cheap, and can be bought at 96. Globe Telegraphs are not affected by the dividend declaration of 1s. 9d. per share.

National Telephones fell upon the "instructions" given by the City to the Lord Mayor to take active proceedings when Parliament meets. The two Preferences are down a pound, but the 4 per cent. Debenture stock is up 2, and a little stock has come to market this week. British Insulated Wire are harder, but both India-Rubber and Telegraph Constructions have still further succumbed to the flatness of the telegraph market. British Westinghouse Preference have advanced to 7⅞, and at 7½ the Ordinary mark a substantial rise on the week.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Jan. 8th.	Closing Quotation Jan. 15th.	Business done during week ended Jan. 15th. 1902. Highest.	Lowest
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	97 —101 xd	97 —101	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	3⅞	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	78 — 83	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	...	47 — 50	47 — 50	49	47½
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	...	87 — 90	89 — 92	90¾	89 11/16
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s. %	...	7½— 8	7⅞— 8½	8⅛	7⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	165 —170	165 —170	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	94 — 97 xd	92 — 96	95	93
16,000	Cuba Telegraph	10	7 %	...	...	5 — 6	5 — 6	5 9/16	...
6,000	Do. 10 % Pref.	10	...	...	...	13½— 14½	13½— 14½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	9⅝	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	98 —102 xd	98 —102	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	9 — 10	9½— 10½	9⅞	9 5/16
101,300	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102 xd	99 —102	100	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	125 —135	125 —135	129	125
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	88 — 92	88 — 92	90	88
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	106 —111	107 —112	111	108
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	12½— 13½	12½— 13½	13	12½
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	111 —116	108 —113	...	..
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	100 —103	100 —103	100	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103	100 —103 %	...	...
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	...	9 — 10	9 — 10	9 7/16	9
180,042	Do. do. 6 % Pref.	10	...	...	...	13 — 14	13 — 14	13½	13
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	27 — 29	27 — 29	...	...
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	93 —103 xd	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	40 — 44	38 — 42	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	102 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	¾— 1	¾— 1	...	...
590,000	National Telephone, 1 to 590,000	5	5 %	5 %	...	3½— 3¾	3⅜— 3⅝	3½	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	12 — 14	11 — 13	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	12 — 14	11 — 13	12	11
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	...	4¾ — 5	4¾— 5	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	...	94 — 97 xd	94 — 97	94	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	...	99 —103 xd	101 —105	104⅞	101½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	...	5/16— 1 1/16	1 1/16—1 1/16	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102 xd	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	120 —125	120 —125	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4¾— 5¼xd	4¾ - 5¼	...	...
40,006	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5 xd	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105 xd	102 —105	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	100 —103	100 —103	102½	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛ — ⅜	⅛ — ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102 xd	101 —104	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	12 — 13	12 — 13	12¾	12¼
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105 xd	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	101 —104 xd	101 —104	...	...
88,321	West India and Panama Telegraph	10	⅝%	...	...	⅜— ⅝	⅜— ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5 — 6	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	2½ — 3½	3 — 4	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	102 105	100 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅜— ⅝	⅜— ⅝	...	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	97 — 102	97 —102	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	...	8¾— 9¼	8¾— 9¼	9 3/16	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8¾— 9¼	8¾— 9¼	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	...	8 — 9	8 — 9	8⅜	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	5 5/16	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	103 —105	103 —105	104	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	...	5 — 5½	5½— 6	5¾	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	108 —111 xd	108 —111	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	...	9 — 10	8½— 9½	8⅞	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	121 —126 xd	121 —126	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	101 —104 xd	101 —104 xd	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	...	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	12⅜	12 1/16
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	103 —108 xd	105 —108	...	..
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	5½— 6	5½— 6	5⅞	5 13/16
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 6	5½— 6	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	106 —109	107 —110	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	103 —106	103 —106	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	94 — 98	95 —100	...	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	...	14 — 15	14 — 15	14⅞	14⅝
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115 xd	111 —115	112	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99 xd	96 — 99	98½	97½
8,652	Notting Hill Electric Lighting	10	7 %	7 %	...	15 — 16	15 — 16	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	...	15½— 16½	15½— 16½	15 13/16	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	...	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100 xd	97 —100	98	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½%	...	11½— 12½	11½— 12½	12 3/16	12½

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Jan. 8th.	Closing Quotation Jan. 15th.	Business done week ended Jan. 15th, 1902. Highest	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	4½ — 5½	4½ — 5½	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	87 — 91	87 — 91	...	...
62,074	British Electric Traction	10	8 %	9 %	...	13½ — 14½	14 — 15	14 5/16	14
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 12½	12 — 12½	12½	12⅜
600,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	128¾	127
70,000	British Insulated Wire Ord.	5	20 %	15 %	...	7½ — 8½	9 — 10	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5¾ — 6¼	5⅜ — 6¼	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	⅞ — 1	⅞ — 1	1	...
50,000	¶ " " " 6 % Cum. Pref.	£1	...	6 %	...	1⅜ — 1⅝	1 1/16 — 1 1/16	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5½ %	5 %	...	1⅜ — 1⅝	1⅜ — 1⅝	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	...	2 — 2¼	1⅞ — 2⅛	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	104	103¼
125,000*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	16½ — 17½	16½ — 17½	17⅜	16⅞
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5¾ — 6¼xd	5¾ — 6¼	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	110 —114 xd	110 —114	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	...	105 — 108	105 — 108	107½	106¼
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	...	105 —108	105 — 108	...	...
440,100	Do. do. Def. do.	Stock	...	...	...	106 —109	106 — 109	107¼	...
855,000	City and South London Railway	Stock	1⅞ %	1½ %	2 %	62 — 64	65 — 67	67	63½
47,500	Do. do. Ord. shares Nos. 22,501 to 70,000	10	...	...	...	6 — 6½	6 — 6½	6½	6¼
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½ %	8 %	...	3 — 3½	3 — 3½	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —104 xd	99 —104	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½ %	...	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½ %	...	2 — 3	2 — 3	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	73 — 83 xd	78 — 83	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	84 — 89	84 — 89	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1¾ — 2¼	1¾ — 2¼	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2⅛ — 3	2⅛ — 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —102	98 —102	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9¾ — 10¼xd	9¾ — 10¼	10⅛	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 — 102	99 —102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	...	16½ — 17½	16½ — 17½	16⅝	...
35,000	Do. do. do. 4½ % Pref.	5	4½ %	4½ %	...	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	112 —116	112 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	...	...	20½ — 21½xd	20 — 21	20½	20
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¾ %	3¼ %	...	4¾ — 5	4¾ — 5	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	11¼ — 11¾	11¼ — 11¾	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500 ...	10	...	...	...	15½—16½	15½ — 16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½ %	...	36 — 40	34 — 38	34	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	102 —104 xd	102 —104	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	...	91 — 94	91 — 94	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance 2/—4/-
National Electric Free Wiring, 17/6 paid, ½—¾.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10⅛—10⅜.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (October 31st, 1901).

MARKET QUOTATIONS, Wednesday, January 15th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	22/-	22/-	..
a " Oxalic	per cwt.	32/-	32/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	89/-	89/-	..
a Ammonia, Muriate (crystal) ..	per ton	£83 10	£83 10	..
a " "	per ton	£80	£80	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a " (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a " Caustic (76/80%) ..	per ton	£24	£24	..
a " Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	125/-	125/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a " Crystals	per ton	£8	£8	..
a Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b " Wire, in ton lots	per ton	£224	£224	..
b " Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £125	£75 to £125	..
c Brass (rolled metal 2" to 12") basis	per lb.	7d.	7¼d.	¼d. dec.
c Tube (brazed)	per lb.	8¾d.	8¼d.	..
c " " (solid drawn) ..	per lb.	7¾d.	7¼d.	..
c " Wire, basis	per lb.	7d.	7¼d.	¼d. dec.
c Copper Tubes (brazed) ..	per lb.	9½d.	9¼d.	..
c " " (solid drawn) ..	per lb.	9½d.	9¼d.	..
g Copper Bars (best selected) ..	per ton	£66	£66	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec
g Copper Sheet	per ton	£66	£66	..
g " Rod	per ton	£66	£66	..
e " Electrolytic) Bars ..	per ton	£70	£70	..
e " " Sheets ..	per ton	..	..	..
e " " Rod ..	per ton	£75	£75	..
e " " H.C. Wire	per lb.	8¼d.	8⅛d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f " Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	8/4 to 8/5	8/4½ to 8/7	dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants) ..	per ton	44/3	43/7	8d. inc.
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	47/6 to 50/-	47/6 to £0/-	..
i " Wire, galvanised No. 8 ..	per ton	£9 10	£10	10/- dec.
g Lead, English Ingot	per ton	£10 10 to £10 15	£10 15 to £11	5/- dec.
g " " Sheet	per ton	..	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d " " " medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large ..	per lb.	8/8 to 7/8	8/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p " rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p " " strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	10d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i " " in bars		£58	£58	..
g Tin, block	per ton	£107 10 to £108 10	£106 to £107	20/- inc.
g " foil	per lb.	1/6	1/6	..
n " wire, Nos. 1 to 16	per lb.	1/5	1/4½	½d. inc.
p White Anti-friction Metals —				
"White Ant" brand	per ton	£85 to £65	£85 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j " 6 lea. Flax	per lb.	5½d.	5½d.	..
j " 8 ply 10 lbs. Russian ..	per lb.	4⅛d.	4⅛d.	..
j " 10 lbs. Russian, single ..	per lb.	4¼d.	4¼d.	..
j " 180 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sh's. (Vielle Montagne bnd.)	per ton	£21 10	£21 10	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakespeare. [Co., Ltd. *h* Messrs. Edward Till & Co. *i* Messrs. Bolling & Lowe. *j* Messrs. Walter H. Hindley & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd *p* The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

REPORT OF THE COMMITTEE ON TRACTION, LIGHT AND POWER DISTRIBUTION ON THE VISIT OF THE INSTITUTION TO GERMANY IN 1901.

(Read January 9th, 1902.)

Ownership of Works.—A close connection between the manufacturers of machinery and the supply of electrical energy in Germany is very noticeable. This intimacy between the supply and demand for machinery is very much to the advantage of both the manufacturer and the user, and in the case of municipalities there is no doubt that while maintaining their control over the work within their area, it has been the means of strengthening and consolidating German manufacturing interests.

In Berlin we find the electricity works owned by a Limited Company founded by and in very close touch with the Allgemeine Elektricitäts Gesellschaft. A few of the early machines are of Siemens & Halske construction, but latterly the whole of the electrical machinery and cables have been supplied by the Allgemeine Elektricitäts Gesellschaft. The company works under a concession from the municipality, which has been renewed on a very much larger scale than the original concession, and has necessitated the building of very extensive works outside the city at Moabit and Oberspree. These works, at present under construction, augment the supply, and will probably in time supersede the smaller works inside the area of supply.

At Charlottenburg, Wiesbaden, Homberg and Bockenheim the works are owned by the municipality and leased to the constructors, Messrs. Lahmeyer, on terms which, while securing a return to the owners on the capital invested, encourage enterprise and extension on the part of the contractors.

Prime Movers.—The first thing that strikes an English engineer on entering a German engine room is the magnitude and frequently the elaboration of the buildings.

The engines commonly used are horizontal slow-speed of from 100 to 80 revolutions a minute, though in some cases vertical engines are found. The finest examples of the latter were the four-cylinder triple-expansion sets seen in the Luisenstrasse Works in Berlin, where three each of 3,000 I.H.P., by Messrs. Sulzer, are at work. It is generally considered that although the vertical engine occupies somewhat less ground space, it costs more in attendance and is higher in prime cost, which may be the reason for the Berlin Company adopting horizontal engines for their new stations where the units are each of 4,500 I.H.P. The personal element also influences the adoption of horizontal engines, as we learn that men do not give the same attention to the working parts if they have to climb ladders to get at them. Those of us who were in the Paris Exhibition last year must have been much struck with the number of men employed on the galleries of such engines as Messrs. Borsig's magnificent vertical.

The enclosed-type high-speed engine so common at home is conspicuous by its absence on the Continent, although some makers are now partially enclosing their vertical types.

In horizontal sets the draught caused by the dynamos has been found to draw the oil from the connecting rods and crank bearings on to the winding, and in order to overcome this the frames or trunks of horizontal engines are now much more enclosed than was usual before dynamo driving had to be considered; the greatest advance in this direction being seen in the new 1,000 I.H.P. sets at present being fixed at the Dortmund Works.

Forced lubrication as understood at home is unknown, though definite plunger feed lubricators are generally used instead of gravity sight feed drop lubrication for cylinders. The highly-finished valve gear on the slow-speed engines would appear to need considerable attention, but it is commonly found that well-finished machinery gets well looked after by the attendants, who take more pride in an engine that looks well when it is clean than in more roughly finished work that barely shows when it is clean or not. Good lubrication and hardened wearing parts for the trips of the valve-gear reduce wear and tear to a minimum, and the engineers in charge report that repairs are insignificant.

Boilers.—Water-tube boilers, with the tubes expanded into a common header, are almost universal, and superheating up to 50° C. is very common, generally by separately fired superheaters, although in some cases nests of tubes are used in the boiler setting. In a few cases economisers are used, but they do not appear to be as general as in England. Furnaces show a very interesting departure from English practice in inclined grates of the Tenbrink type.

In spite of the "Verboten" issued against smoking two years ago, we saw a good deal from the chimneys in many towns. In Berlin the City Council control the emission of black smoke, and for that reason the electricity works are restricted in the use of coal, which, we understand, has been up to the present purchased from Cardiff. At the Moabit Station, which is on the outskirts of the city, a class of coal very similar to our Midland slack is used, while farther out at Oberspree brown coal is used. In both these latter cases we are told no trouble from smoke was experienced.

Bucket elevators and belt conveyers for coal were seen in the A.E.G. Station and the Siemens & Halske's Overhead Railway Plant in Berlin, also in Dresden, though tip-trucks delivering coal in front of the boilers appear to be the rule. Mechanical stoking is conspicuous by its absence.

In Dresden, where brown coal is used and automatically fed on to the grates, the ashes being taken away in the basement, the boiler room is cleaner than many engine rooms. In Essen a very interesting example of firing with waste gases from the adjoining coke ovens has been arranged for, though at present coal is being used.

Generators.—Dynamos are very large everywhere, the slow-speeds generally obtaining making even a 300-KW. machine impressive. Splendid examples of machines of over 1,000 KW. were seen at Berlin, Dresden, Essen, &c. The continuous-current fly-wheel generators are of special interest. These machines are a speciality of the E.A.G. vorm. W. Lahmeyer & Co., and are erected in many of the central stations built by them. Such machines were seen running at the central stations of Dortmund, Dusseldorf, and Homburg.

Two continuous current machines, direct driven by the same engine, and connected alternatively in parallel for lighting, or in series for traction, may be seen in Berlin and Dusseldorf. In Homburg, one engine may be seen driving two generators of different pressure and size for traction and lighting, the traction generator acting as fly-wheel for the whole set. This interesting arrangement requires very little space, and is due to Messrs. Lahmeyer.

The bulk of the new work appears to be on the three-phase system, and the varied use of it is very interesting. Many central stations are built for three-phase current distribution, with continuous-current sub-stations. The oldest German works built on these lines were erected in Bockenheim, near Frankfort-on-Maine, in the year 1892, by the E.A.G. vorm. W. Lahmeyer & Co. These works were also visited by the members. It is specially worthy of mention that from the very beginning, synchronous motors were used for equalising phase differences, and Bockenheim is therefore one of the oldest plants where synchronous motors were used for the said purpose.

The Berlin Electricity Works illustrate the adoption of the three-phase system by a continuous-current company as soon as it became necessary to transmit energy on a large scale from stations at some distance from the centre of the town; with some 30,000 H.P. in continuous-current dynamos, the new stations are laid down at Oberspree and Moabit for a total of 90,000 H.P. with unhesitating confidence in the three-phase system.

At Charlottenburg, with a population of 150,000, the three-phase system has been adopted by Messrs. Lahmeyer at the beginning, but in combination with a continuous current supply, the relative proportions of the two generating plants being about 6 : 4. This station may be taken as a good instance of a modern station of fairly large size (2,000 KW. generating plant) supplying light and power for traction.

In the factories visited a rough guess would place the direct and alternating-current machines under construction at about equal in number and importance, although actually the largest machines were alternators. Under the latter class there were very few single or two-phase machines to be seen. For new work, inductor alternators are practically extinct; not a single one was seen under construction in any of the shops, and although this may have been an accident, certainly their proportion to the whole number built must be small.

The number of direct-coupled machines in course of construction in the workshops of E.A.G. vorm. W. Lahmeyer & Co. was very large. The continuous-current fly-wheel generators for the extension of the Dusseldorf and Dortmund Municipal Works and for the central station at Muenster, driven by gas engines, aroused especial interest, as also did the H.T. 1,600-KW. generators for 10,000 volts direct pressure. A number of synchronous and asynchronous motor-generators up to 450 H.P. for the same high pressure were also nearing completion. A remarkable instance of direct-coupled machines appears in the motors for pumping plants, of which quite a number, varying from 300 to 600 H.P. at 60 to 80 revolutions per minute, were to be seen in the workshops of Messrs. W. Lahmeyer & Co. in course of construction.

For the general purposes of transmission and lighting a standard periodicity of 50 is now almost universal in Germany, the variants of 40 and 60 being seldom found. Rotaries up to 800 KW. are run at this periodicity in the Berlin sub-stations.

Rotaries and synchronous motor-generators were seen in Berlin and Frankfurt respectively under very similar circumstances, both being at work on traction loads, and on their respective merits there was little to be gleaned without a closer knowledge of details. The arrangement of a direct-coupled booster on the alternating side as seen at Augusta Strasse, Berlin, due to Herr Dobrowolski, by means of which the primary pressure can be varied, overcomes the difficulty of the fixed ratio of conversion in the rotary.

Motors.—At Frankfort the larger sizes of the single-phase motors were started in the usual way on a loose pulley. As to the smaller sizes, which were used on lifts, many who saw the mechanism came away with the idea that the lift started simultaneously with the motor (see *Engineer*, July 26th), yet the reporter of the *Electrician* was informed that there was a time arrangement allowing the motor to start before the cage is lifted (see July 19th). We mention this point, although not of great importance, in case there may be further reference to it by others, and by way of caution as to what were really the facts in connection with a rather complicated piece of mechanism.

After experience with continuous-current motors at their Ackerstrasse factory, the Allgemeine Elektricitäts Gesellschaft adopted three-phase motors for their Brunnenstrasse factory throughout, even for their cranes. The reason for this is partly to be found in their adoption of separate motors practically for every tool, the capital outlay on a large number of small motors being at that time (if not now) less, if they were three-phase, than if they were continuous current. In the factory at Oberspree, which is still more modern, although all the tools are driven by three-phase motors, the cranes are again driven by continuous-current motors fed from motor-generators, which also supply direct current for inverted arc lighting.

Although at Oberspree there are some 3,000 H.P. of motors, yet the current is taken from the adjoining central station, though the load must be a constant one, well adapted for great economy in its production; the expense of the step-down transformers must be outweighed by the low price charged for the current.

Other factories also use polyphase or direct-current motors, according to the prevailing conditions, as motive power for their workshops. In the works of Messrs. Lahmeyer & Co. polyphase motors are used for driving groups of machines, whilst single machines are driven by c.c. motors. The new works, situated some distance from the old works and its central station, are driven exclusively by polyphase motors.

Storage Batteries.—The use of storage batteries is much greater in Germany than in this country, the proportion they bear to the generating plant often reaching 20 to 25 per cent. They are used not only to level the load on the generators, but in Frankfort they enable synchronous motor-generators to be used for the conversion of single-phase current to 500 volts continuous current for the trams, such use having been found simple and successful, and it is stated that they completely stop the hunting of the motors.

The batteries in Frankfort are charged by an induction motor-driven booster, and in the Augusta Strasse station of the Berlin Company by a combination of rotary converters and synchronous machines.

The positive plates are generally of the Planté or formed type, while the negative are Faure or pasted type, and maintenance contracts with the makers appear to be the rule rather than the exception.

Cables.—As regards cables for the transmission from Oberspree, over nine miles, 6,000 volts is the chosen voltage, and at this pressure the mains are laid underground. The general type of cable employed by the A.E.G. for transmission at moderately high pressures was said to be insulated with impregnated jute, lead covered and armoured and buried in a bed of clean sand direct in the ground; for pressures from 5,000 to 10,000 volts impregnated jute, rubber and a covering of paper, lead sheathing and armouring; for higher pressures up to 20,000 volts rubber and stabilit instead of jute, experiments being shown to demonstrate the superiority of the stabilit cable at the Oberspree Cable Works. The cables from Oberspree are twisted three-core, and seven are used to feed the sub-station at Mariannenstrasse, which takes about 7,500 H.P., so that the power transmitted by each cable must be at least 1,000 H.P., and probably to allow of reserve capacity, each cable transmits about 2,000 H.P. The best practice appears to be double cables in sections with triple-pole two-way switches, so that the reserve sections may be switched in, in the event of a fault occurring. Lightning arresters are freely used, but we were not able to obtain any definite information about the general practice in transmission lines.

The frequent use in Germany of an uninsulated middle wire in a low-pressure three-wire network is very interesting. It is a very important point, as if it were permitted in this country it would very considerably reduce the cost of networks, although we must admit the benefit to be derived from such a saving is not looked upon by all engineers with equal favour.

Tramways.—For tramways, 550 volts is still the rule, and the sliding bow appears to be extending faster than the trolley.

The span wire is usual, the trolley wire being everywhere kept as close as possible to the centre of the track. The sliding bow introduced by Messrs. Siemens, with its friction surface of aluminium crossed lengthwise for lubrication, gives a simpler overhead construction at curves and junctions and more latitude in the position of the overhead wire. The sliding of the bow gives quieter running than trolleys, but it is very doubtful if, on the whole, the system be preferable to the better examples of swinging trolley equipment seen in England.

The rail joints are often scarfed, which gives smooth running. Lightning arresters of the horn or Siemens type are largely used for traction service, and placed above tramcars with a gap of about $\frac{1}{8}$ in. for 500-volt circuits, the width of the horns at the top being about 5 in. Wider streets, and the fact that cars do not stop, except at their recognised stopping-places, enable high speeds to be run.

Accumulator cars are much used in the centre of large towns, notably in Dusseldorf and Berlin, although in Dresden Messrs. Siemens's conduit system has been adopted through the centre of the town. This modification does not appear to be due so much to economical reasons as to meet the æsthetic views of the municipalities concerned.

High Speed Railways.—The experimental trains in hand at the works of Messrs. Siemens & Halske and the A.E.G. elicited great interest. A few particulars of Messrs. Siemens & Halske's equipment will be found in Mr. Sheardown's paper before the Dublin Local Section, November 14th, 1900 (*vide* Vol. 31, I.E.E. Journal). For further particulars of the latter, we would refer members to Herr O. Lasche's very important description presented in his paper read before the Electrical Section of the International Engineering Congress at Glasgow (*vide* I.E.E. Journal, 1901, Vol. 31, p. 24).

The Suspended Railway.—The Langen Mono-Rail Suspended Railway from Barmen to Eberfeld marks an epoch in railway work. The line, which is rather more than 8 miles in length, runs for some 6 miles over the bed of the winding River Wupper, carried on A-frames about 30 yards apart. The other 2 miles, over narrow streets and country roads, is carried on horseshoe-shaped frames, as they offer less obstruction to traffic than the sloping sides of the A-frames. The under side of the cars is about 15 ft. above the street level. The track is double, providing for "up" and "down" trains of two 50-passenger cars, which are each suspended from two bogies 26 ft. apart. Each bogey has two wheels 35 in. in diameter running on the single rails with an overhung 36-H.P. motor between them, whose pinion engages with spur wheels on the axes of the 35-in. driving wheels.

The 550-volt direct current to the two lines is supplied by separate Sulzer-Schuckert 850-KW. generators. There are also buffer batteries in the generating station, to ensure safety. The current is picked up by contact shoes, which are pressed by spiral springs on to an ordinary round-headed iron rail conductor. The track is divided into automatic block sections, and trains can be run every 3 minutes at a speed of 30 miles an hour. The whole of this novel electrical equipment was designed and constructed by Messrs. Schuckert, of Nuremberg.

Conclusion.—The following figures, though incomplete, will prove interesting.

The Berlin Electricity Works, in their six generating and battery stations, have a total capacity of 84,000 KW, and the highest load observed is 60,000 KW.

In the year ending June, 1900, they generated 62,300,000 units, and sold about 50 millions as follows:—

For	Units.	Prices obtained.
Private lighting ...	11,200,000 ...	6d.
Street lighting ...	800,000 ...	7·2d, including carbons and attendance, plus £6 per lamp for hire, &c.
Motors	17,300,000 ...	1·92d.
Trams	20,000,000 ...	1·08d.
Used on stations ...	500,000 ...	—
Total ...	50,000,000 ...	2·78d.

Cost of coal, Local, 11s., Small Welsh, 17s. per ton.

Costs of labour are not excessive:—

Dynamo attendants and engine drivers ...	4d. to 4$\frac{3}{4}$d. per hour.
Switchboard attendants	4$\frac{3}{4}$d. to 5$\frac{1}{4}$d. " "
Stokers	4$\frac{1}{4}$d. to 4$\frac{3}{4}$d. " "
Cleaners, &c.	3$\frac{3}{4}$d. to 4d. " "

In Dresden the prices charged by the City Light Works are—

For lighting	7·2d. per unit.
For power	4·0d. " "

Cost of local coal, 11s. per ton (poor in quality).

In Dresden Power Station, which supplies the trams, the charge works out at about 1·5d. per unit, but it varies. The city charges the tramways with all the expenses of generating the current, and then takes 25 per cent. of the tramways profit.

In conclusion, the Committee would gratefully record the kind offices of their reporters: Messrs. L. Andrews, A. N. Foyster, C. C. Hawkins, D. K. and J. T. Morris, G. Ralph and J. J. Steinitz, to whom the members are indebted for the details of this report of a most interesting and instructive trip.

(To be continued.)

LARGE ENGINES FOR TRACTION WORK.

OF high-speed engines there are no makers in Europe or in America fit to be compared with our now numerous British builders of both single and double-acting engines of this type. For some reason, perhaps because all the early electric work was of small power, the problem of the electric engine was left alone by the standard steam engine builders of the country, and this left a very open non-competitive field, in which the new high-speed engine makers were enabled to disport themselves and gain experience. It is, however, hardly correct to say, as it has been said, that the builders of large engines did nothing. Hick-Hargreaves, of Bolton, made the Deptford engines, of 1,200 or 1,500 H.P., more than 13 years ago, and had in hand, and partly made, an engine of 10,000 H.P. But no other very large engines were made, and traction work, apart from lighting work, was much delayed by the foolish Tramways Act of 1870, and the still more foolish reading of Clause 43 of that Act—a reading that was surely never intended to be put on it. Then when a few traction schemes came along the plant was brought from America, and the Americans were very clever in selling a lot of, by no means strongly built, engines under the specious excuse that there were huge and incalculable stresses in tramway work, and only American engines were fit for it. This was, of course, just so much nonsense, because strength of parts is not a feature of American engines. True, a tramway load is one of wide and rapid variation, and demands good governing, and American engines, as a rule, had a good type of fly-wheel governor. Americans loudly proclaimed, when the size of engines was demanded greater, that British builders had not built, and could not build, large engines. This, too, though there are probably never absent from New York Harbour larger British-built engines than anything yet built in America! Indeed, we are uncertain if anything so big as 5,000 H.P. through one crankpin has even yet been built there, this being the power put through each of the two crankpins of the ss. *Britannic* fully a quarter of a century ago. We do not know how large are the largest mill engines in this country, but we know that many years ago engines went to India from Bolton of over 4,000 H.P., and, as we have said above, Hick-Hargreaves were prepared to build to 10,000 H.P. in a two-crank engine for Deptford.

To-day everything points to the likelihood of tramway work

being done with large engines. The small high-speed engine type is good up to its proper limit, but we doubt the wisdom of extending its range to very large sizes. Is it asking too much of the makers of large factory engines that they should bestir themselves and realise that the large engine is being called for? Already while they have been sitting still a new large engine maker has entered the field, and Ferranti has taken the contract for the L.C.C. new station.

There is no reason why the old standard factory engine builders need hesitate. For a direct-current tramway service at least it cannot even be claimed that the speed variation must be very small. A small variation in voltage on ordinary occasions, after all, does not impress the tramways engineer so very much when he has seen his cars toiling up a distant hill at about 350 volts with the lamps a dim red and the mains long and under-sized. If the customary type of governor is not quick enough, a quicker governor is not unobtainable. As regards the bogey of American competition and superability, let our factory engine builders see the Glasgow power station and note there the best that America can do, and ask themselves what there is in these engines to warrant all the fuss that has been made and all the claims for superiority. Neither in design nor in finish is there anything extraordinary on the good side, and absolutely nothing to warrant an additional penny in price above the English engines. It is true, we believe, that the American engines were delivered sooner than the Bolton engines, but they were seemingly made to the standard patterns of the American builders, if we may judge by comparing them with the illustrations that appeared of the same makers' productions in the *Engineer*, whereas Messrs. Musgrave had to work to a foreign specification as to sizes and arrangement.

We ask our heavy engine builders seriously to consider the situation, being persuaded that the immediate future will show the wisdom of those firms who first realise that power and traction work is rapidly reaching the stage of big undertakings. Neither in workmanship nor in finish have we seen an American engine equal to the production of British workshops. In durability they are far inferior, owing to the American habit of sacrificing everything to easy shop-work, so that anything like real hardness of cylinder metal is not understood there.

These, and other points, and the general American idea that anything is good enough to export, have tended to open men's minds to the farce that has been so cleverly enacted, and should demonstrate to our builders of big engines that there is really no reason why they need longer stand back. As a sample comparison on general lines of English and American work, we may cite the first tube railway, the City & South London, entirely English in equipment and ask how it is one hears so little about it. It has now been at work for over 11 years, with English equipment throughout, but we hear of no failures. Yet the Central London has had serious trouble with its generating plant—a much-boasted sample of American work throughout. American papers are very full of the fact that the Central London equipment was American. They assume it is because American equipment is better than English. Here, of course, we all know that other causes have been at work, but in respect of heavy steam engine work we feel that the stand-off attitude of our old-established firms has contributed to assist the partiality that has been shown to American plant for no reason, in price, quality, or working economy, that can be discovered.

When makers are tied down too closely by consulting engineers' specifications, the result is apt to be in favour of the particular manufacturer whose patterns most closely resemble the specified type. We think that much harm has resulted to British makers from this practice because, too often, American types have been specified without, in our opinion, any advantage accruing thereby, and this is a point that might well receive attention not merely from our British engine builders, but also from our municipal authorities who have public money to spend, and too frequently have been frightened by the loud abuse of British work by interested foreigners. It is because of the rubbish that has been talked and written of the terrible stresses upon the steam engines in tramway stations that we write this. Such stresses do not exist.

Let us examine the action on a traction set. The designer of the steam engine fixes the latest period of cut-off, and he fixes the maximum initial pressure and loads the boiler safety valve to prevent this maximum being exceeded. He has now three data to go upon, namely, cylinder area, pressure, and the crank position for maximum moment. The maximum crank cannot exceed the mechanical crank length. The stress thus found may come upon the engine every stroke. The parts are, therefore, calculated to bear this stress. If the resistance of the generator exceeds this maximum engine power, then the engine will slow down. The worst that can happen in the way of stresses is when a period of no current is followed by the maximum demand. As this demand finds the engine with only steam enough in it to overcome friction, the load is dealt with by the fly-wheel, which begins to slow down and admits, through the governor effect, full steam to the engine. This, being calculated for full steam, simply works up to its maximum exactly as if it had had full steam for the previous hour or 10 hours or 10 days. With a marine engine the worst stress that can happen is when the propellor is flung into the air and dropped back into solid water, and all the effects of a racing propeller and a stationary mass of water subject to the laws of motion are brought to bear on the shaft. Here are stresses, indeed, with which a traction load cannot compare. The maximum sudden current demand on a generator requires time to grow to a maximum, perhaps half a second. It is not a material shock. It has not even the inertia effect of an atmospheric fan brake. Any stress it may set up will be in the arms of the fly-wheel and in the shaft between the fly-wheel and the generator. Hence the wisdom of transmitting all fly-wheel effort direct to the generator spider.

Curiously enough, American designers, while so loudly proclaiming the great stresses they alone are competent to tackle, neglect the only points where such stresses can exert effect, and sometimes place the fly-wheel at one end and the generator at the other end of the shaft, so contradicting their own bogey. That this bogey has paid the Americans is largely the fault of the British engine makers, who, if they did not believe it, have allowed town clerks and aldermen to remain unenlightened, and judgment has gone by default.

Of course, it is not to be denied that in traction work the range of load is wide, and the load fluctuates continuously. But this does not imply stresses other than above indicated, though it may demand a difference in the governing arrangements, especially in alternating work. But in large engines with their comparatively steady loads, it appears, if the Glasgow engines are any guide, that a very ordinary Corliss gear suffices to give satisfaction. Wherein can the Glasgow engines be said to depart from factory types? Not even in the provision of fly-wheel effect, for the fly-wheel effect is not comparatively large. Many factory engine rope-rims for 1,000 I.H.P. have wheels of 70 tons for two-crank engines, and this is closely the equivalent of a wheel of 150 tons for a 5,000-H.P. engine, even when the speed difference is allowed for.

Where, then, is the reason for any neglect of power and traction work by English engineers? Simply nowhere, in truth.

CURRENT SPECIFICATIONS.

LXXXVIII.—HARTLEPOOL ELECTRIC LIGHTING.

SUMMARY.

Extent of Contract.—Supply, delivery, and erection, under different sections, of plant suitable for electric lighting scheme. Sec. No. 5, switchboard. Sec. No. 6, arc lamps.

Switchboard.—To be suitable for the control of two 120-KW. generators, a combined balancer and booster set, a battery of 260 cells, four arc lamp circuits, and two feeder circuits.

Design of Board.—Left to the discretion of the tenderer, the types of instruments being specified in detail.

Voltage of Circuit.—Three-wire low pressure, with 230 volts between middle wire and either outer. The dynamos are wound for voltage across outers of three-wire system.

Number of Arc Lamps.—Forty, to be arranged to burn 10 in series across outers with 460 volts. Number may be increased to not more than 60 lamps.

Type of Lamp.—To be double carbon type, 12½-ampere size, suitable for burning 16 hours without recarboning.

Specified Cost of Carbons.—Not to exceed *one-eighth of a penny per lamp-hour.*

Lamp Posts.—To be supplied under another section.

Alternative Tender.—An alternative tender may be submitted for providing silver-backed incandescent lamps entirely in place of the arc lamps.

Specified Date of Completion.—Eight months from date of order.

Penalty for Late Completion.—Two pounds (£2) per day for either section.

Specified Terms of Payment.—Up to 75 per cent. of value of work executed during progress of work. Three-fifths of balance = 15 per cent. of whole sum within one month from date of engineer's certificate of completion, remaining 10 per cent. at end of period of maintenance.

Maintenance Period.—Twelve months from date of completion.

Sureties.—Two to be provided, to be jointly and severally bound in a sum equal to *twice* the contract sum.

Stipulations as to Removal of Foreman.—Fairly satisfactory.

Stipulations as to Wages to be Paid to Workmen.—None.

Arbitration Proposals.—Very unsatisfactory. See comments below.

Date for Receipt of Tenders.—January 25th, 1902.

This specification is prepared and issued by Mr. H. C. Crummack, A.M.I.C.E., the borough engineer to the Corporation of Hartlepool.

It is in many respects unsatisfactory. Dealing with the sections mentioned in detail above, viz., those for the switchboard and arc lamps, we find that the powers of the engineer are very arbitrary, practically everything having to meet with his approval, while as regards requirements he leaves this, to a very large extent, to the judgment of the tenderer. Such details as the type and length of scales of the various instruments are given great prominence, but information as to the desired arrangement of the board, and those requirements which determine, to a large extent, its cost are conspicuous by their absence. The same criticism applies to the arc-lamp section; it is possible in widely different ways to meet the specification, and items which may prove very expensive, and which are, to a large extent, out of the control of the contractor for that section, have to be included in the price. Such, for instance, is the cost of jointing, which must be carried out by the contractor for the mains, though paid for by the contractor for the arc lamps.

Such clauses unnecessarily increase the cost of the work, and at the same time render it very difficult to estimate its probable value.

The general conditions are amongst the worst we have lately examined.

No provision is made for arbitration, the engineer having the sole power to decide any differences of opinion which may arise, and it

only needs a careful reading of the specification to convince one that there is a great probability of disagreement as to the meaning of a number of the different clauses.

The terms of payment are, on the whole, acceptable, though some provision should be made for the possible retention of 25 per cent. of the contract sum until one month after receipt of the engineer's certificate of completion. Tenderers will note that there is no appeal from *his* interpretation of the term "completion," and that it is expressly stipulated that *he* may, if he thinks fit, withhold or withdraw his certificates.

It is necessary for tenderers to propose two sureties, who shall be jointly and severally bound in a sum equal to *double* the tendered amount. This, in our opinion, is preposterous, and should be strongly objected to, the usual 20 per cent. of contract sum being offered in place of the 200 per cent. demanded.

We strongly advise all tenderers to be careful, in sending in offers, to object to such clauses as the above. They are unfair to all parties, and it is only by combined action that such demands can be successfully withstood.

HIGH SPEED STEAM ENGINES.*

BY JOHN DAVIDSON.

(*Continued from page* 79.)

SINGLE-ACTING engines are also made in the enclosed type, but they mostly depend only upon the splash caused by the crank dipping into a well of oil for the lubrication of all the other parts, and this appears to be a very efficient means of lubricating this type of engine, but would not answer the purpose in the double-acting engines, the bearings on this type of engine being closed-in all round and no space available for the oil to enter unless very special means be made for distribution of the oil. Then, again, with oil only flowing into the bearings by gravity, it is not possible to spread a film over the surfaces in such an efficient manner as when it is there under pressure ready to spread itself immediately the pressure between the two surfaces is reduced or entirely taken away. It is certainly owing to this most perfect system of lubrication which is used in connection with double-acting engines that the wear is so small, and from the tables which the author gives below it will be seen that the wear in a quick revolution engine is, if anything, less than that which takes place in one of the old slow revolution horizontal mill engines. The following is a report on the wear of various parts of a Willans patent central valve compound engine of 80 I.H.P. after five years' work. The engine was used for lighting a ferry works, and for supplying power to the various electric motors. The average run was 13 hours per day, for six days a week; total run amounts to about 1,560 days, or 20,280 hours, or about 535,392,000 revolutions.

LOW-PRESSURE TRUNKS.

Wear from gland rings; steam gland ring has reduced trunk	·002 in. in diameter.
Air buffer; steam gland ring has reduced trunk	·015 in. "
Inside wear, due to the valves, could not be measured accurately, but it amounts to about	·002 in.

HIGH-PRESSURE TRUNKS.

Outside wear due to gland rings	·003 in.
Inside wear due to valves (approximately)	·002 in.

CYLINDERS.

		Inch.		Inch.	
L.P. cylinder, wear at the top portion ...		·008	and	·001	oval.
"	midway, wear	·007	"	·0015	"
"	bottom of cylinder, wear...	·009	"	·002	"
H.P. cylinder, wear at top portion ...		·022	"	·0015	"
"	midway, wear	·0265	"	·001	"
B. "	bottom of cylinder, wear ...	·025	"	·0015	"

Connecting rod brasses, worn in the crown, ·02 in.

Cross-head pin, maximum wear on one portion, ·002 in.

Valve guide pin, wear due to little end of eccentric rod, ·004 in.

Connecting rod, small end bush, wear, nil.

Eccentric rod, wear in the bush in the small end is ·002 in. in diameter. Total wear between eccentric shaft and pin amounts to ·03 in., and in the strap varies from ·075 in. to ·15 in.

Crankshaft.—The grooves worn at the ends are $\frac{1}{16}$ in. in depth at the governor end, and $\frac{1}{32}$ at the dynamo end.

Journals.—The wear on the journals varies from ·001 in. to ·002 in., while that on the eccentrics is nil. That on all four crankpins is ·007 in., all being quite alike, but they may have been as much as ·003 in. below standard size originally (this being the maximum deviation allowed from the standard size). All pins and journals are absolutely round.

Main bearings.—The wear in these varies from nothing at the governor end to ·016 in. at the dynamo end.

* Paper read before the Liverpool Engineering Society on December 4th, 1901.

As will be seen from the above table, the wear after five years' work was not appreciable, and speaks wonders for the design of the engine, and also for the care it must have received while running.

Below I give a detailed report on a Belliss double-acting self-lubricating engine which had been in continuous daily work for three years driving a generator by belt drive.

REPORT OF DYNAMO ENGINE.

"When opened up the engine was found to be in a very satisfactory condition generally. The cylinder surfaces were in splendid condition, and there was no sign of grooving upon them. The bearings were all slightly ridged by grit but not much worn, wear being as per following statement. The oil strainer was not of our present type, with very fine gauze. The wood lagging on the separator was loose, but not charred. The lagging on cylinders in capital condition. The wear as measured was found to be as follows:—

	Inch.		Inch.
Crankshaft main bearing journal	$\frac{8}{1000}$ to $\frac{6}{1000}$	H.P. crankpin	$\frac{10}{1000}$
		Eccentric sheaves ...	$\frac{10}{1000}$
L.P. crankpin	$\frac{10}{1000}$	L.P. crosshead pin ...	$\frac{6}{1000}$
H.P. crosshead pin ...	$\frac{8}{1000}$	H.P. cylinder	$\frac{6}{1000}$
Valve rod crosshead ...	$\frac{6}{1000}$	Piston rings open at joints	$\frac{1}{16}$ full
L.P. cylinder	$\frac{10}{1000}$		

"The total wear of the shaft and brasses—*i.e.*, amount the bearing caps have been let together—was $\frac{16}{1000}$ in. at the governor end and $\frac{21}{1000}$ in. at fly-wheel end.

"*Valve Rings.*—The thickest feeler which could in any way be passed between the solid valve ring and the valve chamber bore was found to be $\frac{6}{1000}$ in., representing, say, $\frac{4}{1000}$ in. wear from original dimensions.

"In re-erecting care was taken not to interfere with the piston or slide valves beyond cleaning them, and before despatch a careful test of the engine was made, when it gave a result little if anything worse than similar engines previously tested, the water consumption being 23·4 lbs. per B.H.P. as compared with the result of 23·3 and 23·07 obtained from two engines of the same dimensions recently tested on brake under conditions very closely approximate.

"In view of the very highly satisfactory results, it was decided to return the engine without any alteration to the pistons, rings, or slide valves."

From the above reports, which are examples from actual practice, I think it can safely be said that the quick revolution engine is one which does not wear very rapidly, and is a very favourable competitor of the ponderous slow-revolution open-type engines.

The quick revolution engine is one which can be relied upon, and is not subject to breakdowns. In support of this statement, the author will quote an instance of one engine which has been at work almost continuously, day and night, for nearly four years.

REPORT ON DYNAMO ENGINE (No. 2).

"In one year it ran 99·77 per cent. of the total hours, the longest run without stopping being from July 1st to November 30th, during which time the combined steam dynamo made 85,000,000 revolutions without stopping.

"The engine still runs absolutely noiselessly, and has required practically no repairs or adjustment.

"The records show that there have been no hot bearings or failure of the oil supply.

"The steam cylinders were last opened out for inspection 12 months ago. They haye just now been again examined, and found in perfect condition, the cylinder surfaces being extremely good.

"The wear on the working parts that were measured was found to be extremely small, and fully bears out a similar report taken some months ago on a similar engine."

Economy.—The only fair method of comparing the steam consumption of engines is by measuring the weight of steam used per brake horse-power, as by measuring the indicated horse-power the mechanical efficiency of the engine is not taken into consideration, varying very considerably in different types of engines. For instance, the mechanical efficiency of an ordinary well-designed and built slow-speed engine of about, say, 500 H.P., may be taken as a maximum from 88 per cent. to 90 per cent. at the full load; a single-acting quick-revolution engine, with splash lubrication, a maximum of about 90 per cent.; a double-acting engine of the forced lubrication type, from 91 to 93 per cent., and even 96 per cent. has been attained in special cases.

The high mechanical efficiency obtained with engines of the quick-revolution type is mainly due to the perfect system of lubrication adopted, and the lightness of the parts. There are many other things, however, besides the mechanical efficiency of an engine, which have considerable effect upon the steam consumption per B.H.P., as, for instance, the following:—

Jacketting of cylinders.

Whether the steam be superheated or saturated.

Surfaces exposed to atmosphere, and consequent loss due to radiation.

Method of governing adopted, whether throttle or automatic expansion.

To deal with all these points in detail would require another paper at least, so the author must be content with speaking generally on the various points, and leave you to judge for yourselves as to the ultimate results, from actual tests of engines of the various types.

Jacketting of cylinders appears to have very little advantage with engines of the short-stroke quick-revolution type, and the quicker the engine runs, the less appears to be the advantage, so that now the majority of quick-revolution engine builders do not jacket the cylinders, having found that the gain resulting therefrom is not worth the extra expense entailed.

Superheating, of course, has a most beneficial effect in reducing the initial condensation practically to a minimum, according to the degree of superheat used. This applies to both quick-revolution and slow-revolution engines alike. Superheated steam, although used many years ago, appears to have been abandoned owing to the mechanical difficulties caused thereby in the engine itself, and has only recently been taken up seriously as something worth using, and whereby great economy might be obtained.

Respecting the areas of surfaces exposed for radiation, &c., on this point the quick-revolution engine scores heavily, and all that may be said here is that the quicker you run the engine the less the surfaces exposed; as the quicker the engine runs the less the size of cylinders required for a given power.

The type of governor adopted, of course, has a similar effect on both types of engines—either quick or slow revolution, but we have yet to learn what is the difference in economy between variable expansion and throttle governing, when highly superheated steam is used; perhaps the throttle governor will then lose some of its present great reputation.

Mr. Willans found that by increasing the speed of rotation of an engine, very appreciable gain in economy was effected, due to the shortness of time the cylinder walls and ports were exposed to the temperature of the exhaust steam, and the reduced initial condensation thereby.

As actual facts are what are wanted, and it is no use supposing this and something else will give economy, the author gives you the result of various tests for comparison, from which you can judge for yourselves which is the most favourable engine—quick or slow revolution, not forgetting that besides the gain in economy the quick revolution engine is the cheapest in first cost—foundations cheaper, buildings cheaper; and if the engine is coupled direct to a generator, the generator is cheaper.

ECONOMY TESTS.

TEST OF WILLANS ENGINE at Messrs. Gunning & Campbell's Mill, Belfast, October 4th, 1894.

Duration of Tests: First, 4·29 hours; second, 3·52 hours; third, 3·55 hours; and fourth, 3·05 hours. Effective area of cylinders (three of each): High pressure, 90·836 sq. in.; intermediate, 345·44 sq. in.; low pressure, 587·175 sq. in.; stroke, 10·24 in.

Mean boiler pressure above the atmosphere	190 lbs. per sq. in.
Mean admission high pressure cylinder	169·5 lbs. per sq. in.
Mean effective pressure on low pressure cylinder	28·918 lbs. per sq. in.
Mean vacuum	25·925 in.
Mean revolutions per minute ...	299·8
Mean I.H.P.	394·775
Mean total feed-water per hour ...	5,050 lbs.
Mean deductions for separator and other drains per hour	117·1 lbs.
Mean total steam to engine per hour	4,932·9 lbs.
Mean steam used per I.H.P. per hour	12·49 lbs.
Temperature of feed to economiser	113°
Temperature of feed to boiler ...	243°
Coal burnt per hour	457·6 lbs.
Coal burnt per square foot of grate area per hour	14·3 lbs.
Coal burnt per I.H.P. per hour ...	1·185 lbs.
Pounds of water evaporated per lb. of fuel	11·1
Pounds of water evaporated per lb. of fuel from and at 212° F.	12·83
Pounds of water evaporated per square foot of heating surface per hour	5·58

TRIAL OF BELLISS 250 H.P. QUICK REVOLUTION SELF-LUBRICATING ENGINE, WHEN GOVERNED BY THROTTLE VALVE.

Cylinders 12 and 20 in. diameter, with 10-in. stroke. Boiler pressure, 150 lbs. per sq. in. above the atmosphere.

—	Full load.	Five-eighths load.	One-third load.	One-quarter load.
Mean effective pressure per sq. in. reduced to low-pressure cylinder, lbs.	40·1	25·9	15·7	10·9
Mean revolutions per minute ...	370	370	380	382
Mean indicated horse-power ...	235·4	152·2	95·0	66·2
Mean electric horse-power ...	213·0	132·2	77·8	53·0
Combined efficiency, $\frac{\text{E.H.P.}}{\text{I.H.P.}}$ %	90·4	86·8	81·9	80·0
Water per hour, total ..... lbs.	4,473	2,871	1,992	1,505
" " per E.H.P. lbs.	21·0	21·7	25·6	28·4

TEST OF BROWETT-LINDLEY ENGINE.

Engine 200 KW. size, 350 revolutions per minute, 130 lbs. steam pressure, 100° superheat, 26 in. vacuum.

This engine, after 18 months' continuous running, of about 16 hours per day, was tested for steam consumption by the electrical contractors. No notice of test was given to the engine builders, and no preparation was made for the test. No adjustments have been made to the engine since first installed. The engine runs exceedingly quietly on load, and the steam consumption at three-quarters of full load worked out to be 24 lbs. per KW., or about 17·9 lbs. per E.H.P. As this engine is most economical at the full load, the steam consumption is very satisfactory, and considerably under the guarantee.

(To be concluded.)

A LAMP ON A NEW PRINCIPLE FOR LIGHT TREATMENT.*

DR. S. BANG, manager of the Laboratory in Finsen's Light Institute writes a preliminary notice on a new lamp. He observes that the arc lamp has hitherto been used as the artificial source of light. But as the therapeutically active rays (the blue, violet, and ultra-violet) are mixed with a number of indifferent and partly harmful rays, it was necessary to remove them by an energetic filtration process (through water), a proceeding which results in only a small portion of the initial energy being left for effective use. The apparatus of Lortet and Genoud to some extent got rid of this difficulty, by making it possible to bring the patient very close to the arc by means of the interposition of a glass screen, which is cooled by a current of water.

Both methods possessed the disadvantage in common that the only lamps available were constructed for optical purposes, and no lamp existed so constructed as to produce the coldest light, whilst at the same time the richest in ultra-violet rays.

The author states that he has now succeeded in constructing such a lamp by using metals of suitable spectral properties, as, for instance, iron, the spectrum of which is well known to be very rich in the desired rays, as electrodes; and this has been possible by cooling the electrodes by water, either by making them hollow and letting a current of water pass through, or by making larger lamps and placing them in water contained in a suitably constructed vessel.

In this simple way a light of unexpected properties is obtained. While with the carbon electrodes the greatest quantity of light comes from the points of the incandescent carbons, especially from the crater of the positive carbon, the arrangement in question gives a real arc light, as it is almost exclusively the arc between the electrodes that emits radiation. The effect of the cooling is, therefore, not only prevention of the fusing of the electrodes, but also that the formation of the crater is much reduced; the energy developed thus passes to the arc, and the arc rays are produced rather than the electrode rays.

The bactericidal power of these rays is such as has not hitherto been realised. Whilst the usual arc lamp of 25 amperes and 55 volts at 66 cm. distance, and under the most favourable conditions, kills Staphylococcus pyogenes aureus in 4½ minutes, the latter is killed by the lamp described, with iron electrodes and equal power, and other conditions, in somewhat less than 4 seconds, which shows a bactericidal power of 60 times that of the usual arc light. Similar results are shown regarding the irritant effects on the skin of these cold rays. Five minutes' radiation at 1 metre distance from the lamp is sufficient to produce a well-marked light erythema of the whole face, which lasts for several days.

For local treatment the writer explains that he has constructed quite a small lamp, which, including various adjuncts, is not much bigger than a tablespoon. This lamp is placed upon the skin *in toto*, as the light arc is so cool that it can be placed at 1 to 1½ cm. from the skin. More than 150 trials, upon sound as well as upon lupus skin, have shown that a lamp of 5 amperes and 40 volts gives in 5 minutes (generally in 3 minutes) over a surface of 10 sq. cm. light reaction of the same strength as from the usual apparatus of 60 amperes and 50 volts in 1½ hours. In other words, to obtain this effect with the old apparatus 13,500 KW. seconds were necessary, which treated four patients, therefore 3,375 KW.-seconds per patient, whereas with the new lamp only 60 KW.-seconds, or $\frac{1}{56}$th of the energy formerly consumed. As is quite natural, the effect is higher if a stronger current is used, but as the effect of the usual lamps is in practice nearly proportional to the amperes, it would appear that the bactericidal power of the new lamp is proportional to the whole quantity of energy, or to the number of watts (5 to 10 amperes and 30 to 50 volts). The most suitable current seems to be 8 amperes and 40 volts. As the light of this lamp is very powerful no concentration is necessary. In consequence of this, and as no automatic regulation is necessary, the lamp is very cheap to construct, and it can be used on any ordinary installation for incandescent lamps

Tramways and Light Railways Association.—Mr. Thomas W. Howe, F.R.G.S., managing director of the "Empire" Roller Bearings Company, Limited, was last week elected a member of the Council.

* *Journal of Physical Therapeutics.*

APPLICATIONS AND USES OF ARC LAMPS.

(*Concluded from page 74.*)

THE "P" type lamp still holds its own for all purposes where first cost is not of moment, but where a strong substantial lamp, capable of standing hard and rough usage is the chief consideration.

Among instances of this description one might mention street lighting, railway station lighting, iron and steel works, &c.

Even in the case of a cheap lamp, however, reliability and freedom from breakdown is of vital importance, as these lamps find their way into the hands of unskilled attendants, almost more so than the more expensive lamps, which are sold largely to engineers who understand the attention they require.

The "S" type lamp, which has now been on the market since 1895, has been successful to a marked degree in fighting the cheaply-made foreign lamp, which, although only slightly cheaper in first cost, due to lighter build, is considered by many to be more expensive in maintenance.

In addition to being low in price, this "S" lamp has the further advantage of being very short, and consequently of being better fitted for interior lighting where headroom is limited.

Although primarily introduced for use in positions where the burning conditions were not severe, such as interior lighting, the "S" type lamp has not stopped here, but has been used in many cases for street lighting, in the dirtiest positions in iron and steel works and foundries, and, in fact, under the most adverse conditions with satisfactory results.

Even after the introduction of the "S" type lamp there was no rest for arc lamp manufacturers. Shortly after this the enclosed long-burning lamp was brought over from America, and arc lamp manufacturers in this country were told that they might as well close their shops as go on making the open-type lamp.

It was not difficult to appreciate that lamps of the enclosed type would have certain advantages when applied to special cases, and that unless their manufacture was undertaken, the supply would have to be obtained by importing from abroad. Under these circumstances, Messrs. Crompton, among other makers, decided to bring out a long-burning double enclosed lamp, which could be sold at about the same cost as their "S" type lamp, and

FIG. 5.

their efforts in this direction culminated in the introduction of the "Chelmsford" long-burning arc lamp.

This lamp is illustrated in fig. 5, from which it will be g thered that the lamp can either be suspended with the fittings shown, or the top fitting can be removed and the lamp screwed direct into a pipe, as shown in fig. 1, to ensure a rigid suspension.

Although there was a certain truth in the advantages held forth for enclosed type lamps, yet this type of lamp has not yet made the impression upon the arc lamp industry which some thought it would.

It should be borne in mind that many of the manufacturers and importers of enclosed lamps confine their attention to this pattern only, and consequently their opinions as to the merits and adaptability of this type of lamp must, to a large extent, be biassed.

Actual experience in this country, extending over some years' use, seems to point to the fact that for lighting open spaces, factories and works, where sufficient head room is available, and where a strong light is required, the open type of lamp is preferable; whereas for lighting shops where the head room is limited, or for lighting retail establishments, where the double globes have an advantage from the fire insurance point of view, and where minimum attention in trimming is of considerable importance, the enclosed lamp has advantages.

Further, for equal power, the enclosed lamp, although giving a more distributed light, which can be put to considerable use, as referred to previously, where the head room is limited, does not give out so much light as the ordinary single globe 45-volt arc.

It is not intended by this to decry the merits of long-burning enclosed lamps, as they have their distinct spheres of usefulness. They should, however, be installed with discretion, and cannot be used to best advantage to meet all cases.

We propose now to pass on to a more detailed technical description of the "P," "S," and "Chelmsford" lamps, at the same time going into the various burning conditions, and emphasising and criticising the running conditions which one finds in every day use.

CROMPTON-POCHIN "P" TYPE ARC LAMP.

This type of lamp is made either for single or double carbon burning, and can be used either on direct, alternating or rectified circuits.

The lamp is of the rack-rod type, with a brake wheel escapement for enabling the rack-rod to feed down when the lever, which is usually controlled by two solenoids, a series and a shunt, gets into the feeding position.

The top of the lamp is arranged in such a way that the mechanism and base of the lamp can be lowered from it, and the act of doing this entirely cuts off the current from the lamp, which enables the trimmer to work away at the lamp without any fear of shocks. This means that the leads are brought into the top cover, and only when the lamp is closed and in the working position is the current switched on to the lamp. The brake surfaces are all metal, and therefore last for years without renewing. Rubber and other materials are frequently used in other lamps in order to get a more delicate feed, but these soft brakes have to be renewed frequently, and, in fact, do not give in everyday use the delicate feed they show on test. Messrs. Crompton therefore prefer to use metal brakes, which will last for years and by careful attention to design, give a feed which is sufficiently sensitive to meet all practical requirements, as can be gathered by the many fine examples of street lighting by Crompton lamps throughout the kingdom.

The delicacy of feed also remains practically constant throughout the life of the lamp, if this is only given ordinary attention.

Direct-Current Lamps.—When lamps are required for burning four in series, the question frequently crops up whether an automatic cut-out and substitutional resistance is necessary. It is evident that if one lamp hangs up, or the carbons become exhausted, due sometimes to inattention on the part of the trimmer, the remainder will go out and may cause inconvenience; also the shunt of the lamp that has hung up will be thrown into series with the remaining arcs, which will have fallen together, and consequently will receive practically the full circuit volts across it, and will thus run the risk of getting burnt up. These two dangers can be avoided by fitting automatic cut-outs and substitutional resistances to each of the lamps.

The automatic cut-outs can be fitted either in the lamps themselves, or externally; in either case they can be of the resetting or of the non resetting type. If of the resetting type, the cut-out lamp will start up again automatically, if the carbons fall together again—if of the non-resetting type, the switch must be turned or the cut-out re set before the lamp will start up again. A lamp fitted with an internal cut-out is more self-contained, but, on the other hand, space inside the lamp is limited, and it is easier to make a satisfactory external cut-out.

On the whole, if there is room for fixing an external cut-out, it is to be recommended.

Perhaps the best answer as to whether to use cut-outs and substitutional resistances would appear to be that there is no actual necessity for them in the case of lamps burning four or more in series.

If the lamps are properly looked after and cleaned the chances of their hanging up are remote, and even if one did hang up, the fact that all four lamps went out would soon attract the attention of the attendant.

On the other hand, if a few shunt coils were burnt up during the year, the total cost of them in a well looked after installation would represent a small percentage on the extra capital outlay for the cut-outs and resistances.

For circuits of, say, 10 lamps in series on a constant potential circuit the matter is different, and here it is advisable to have an automatic cut-out and substitutional resistances to each lamp, as in the event of one lamp hanging up, the whole series of 10 lamps going out would be a serious matter.

In cases, however, where a considerable margin is allowed between the circuit volts and the total volts required by the lamps, substitutional resistances may be omitted, and short-circuiting cut-outs only provided.

For circuits above this number of lamps in series, it is scarcely necessary to have substitutional resistances, but merely automatic short-circuiting cut-outs, as the volts taken by one lamp, should it fail, can, without difficulty, be distributed over the remainder.

In the case of lamps run on a constant-current circuit, short-circuiting cut-outs only are necessary.

In the case of internal cut-outs and external substitutional resistances, three wires come away from the lamp in place of two.

The necessary regulating resistances for lamps on constant potential should be placed external to the lamps, and not internal.

Alternating Current Lamps.—A great many lamps of this type are used on alternating circuits with very satisfactory results.

On the whole, however, the "S" type lamp gives quite as satisfactory results on alternating circuits, and consequently is usually put forward.

Some important remarks are made under this heading regarding the "S" type lamp, which apply equally to the "P" type, and should therefore be noted.

Rectified Circuits.—With the exception of a few details in construction, the lamps intended for burning under these conditions are similar to those for continuous current circuits.

CROMPTON-POCHIN "S" TYPE LAMP.

This type of lamp has in the past only been made for single carbon burning, and can be used either on continuous, alternating, or rectified circuits.

The lamp is of the band brake type, which enables a very short design to be made compared with the rod type of lamp.

As in the "P" type, a series and a shunt solenoid is provided, and the iron cores of these are attached respectively to the ends of a rocking lever, to which is also attached one end of the brake.

This brake, which takes the form of a chain or band of metal, is then passed round a wheel or drum, and its other end is attached to a flat spring.

On the drum are coiled a pair of flexible connectors, one of which is attached to the descending and the other to the ascending carbon holder, so that the rotation of the drum in one direction or the other controls the movements of approach, or the drawing apart of the carbons.

The tension on the brake chain is determined by the position of the rocking lever, which, in turn, is controlled through the iron cores by the currents passing in the two solenoids.

This brake mechanism, whilst affording an extremely sensitive and practically continuous feed, is exceedingly powerful, and effectually prevents any slipping together of the carbons when the lamp is subjected to severe vibration from any cause.

Direct Current Lamps.—There are no special remarks to make under this heading, as the remarks made under the "P" type lamp also apply here.

The cut-outs either of the resetting, or of the non-resetting type, can be fixed either internally or externally, to suit the requirements of the case.

Alternating Current Lamps.—This design of lamp is specially suitable for burning on alternating circuits.

Lamps can be run in series on alternating circuits in one of three ways.

(*a*) Two or more lamps, provided with main and shunt coils, may be run in series with an external choking coil, which takes the place of the resistance in continuous current lamps.

(*b*) Two or three lamps may be run off a special lamp transformer. This arrangement has the merits that the lamps can be switched off independently of one another, whilst so far as current consumption is concerned, the primary input is for all practical purposes in direct proportion to the number of lamps burning, and what is an important point, no shunt coil is required in the lamp.

In series running of alternating arc lamps the weakest part is undoubtedly the shunt coil, which is somewhat liable to become overheated and burn up, consequently running them off a transformer, as described above, is cheapest in the long run.

(*c*) Finally, when a number of alternating lamps are run in series, the compensating system is often adopted, which consists in placing a compensating coil or choker across the terminals of each lamp. This compensating coil dispenses with the shunt coil of the lamp, with the automatic cut-out, and, finally, with the substitutional resistance. A choking coil is placed in series with the lamp circuit for taking up the excess circuit voltage, unless, as is sometimes the case in long series burning, a constant current transformer is used.

"CHELMSFORD" ENCLOSED LONG-BURNING ARC LAMP.

These lamps are extremely simple in design, and can be made with a minimum of alteration for direct, alternating, or rectified circuits.

It has been a great temptation to place the necessary steadying resistance inside the lamp, and although this has been done by some makers, thus enabling them to sell the lamps self-contained, ready for coupling to the mains, there is always the fear that excessive heat may be generated inside the lamp, to the detriment of satisfactory working.

The following is, therefore, the arrangement advocated by Messrs. Crompton as being the most suitable.

Direct Current Lamps.—Lamps for burning singly can be fitted with the necessary resistance internally, to enable them to be coupled up direct on 100 to 110-volt mains. It is, however, preferred that this resistance should be external.

Lamps for burning in series are supplied with external resistances of the usual pattern, but a resistance arranged in a dome or canopy, to be suspended above the lamp can be supplied at a small extra charge. A lamp fitted in this way is shown in fig. 6. Either steadying or substitutional resistances can be fitted inside these canopies. This arrangement, whilst making the lamp and resistance practically self-contained, has the advantage of considerably better ventilation. Internal cut-outs can be provided when desired.

FIG. 6.

Alternating Current Lamps.—Lamps for burning singly are fitted with the necessary choking coil internally, to enable them to be direct coupled on to 100 to 110 volts, the choker being adjustable to suit various periodicities.

Lamps for series burning, however, are arranged with an internal compensating coil and external adjustable choker, or are arranged to run off special lamp transformers when the circuit voltage is suitable, as in the case of open arc lamps.

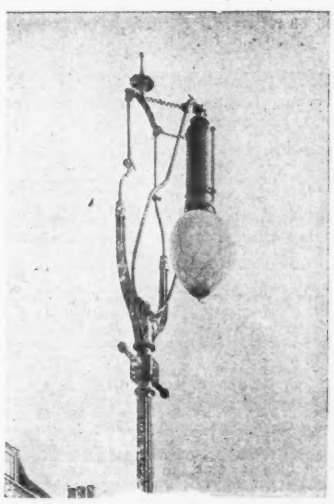


FIG. 7.

In addition to their standard lamps, Messrs. Crompton & Co. manufacture lamps for special purposes, such as photographic, lighthouse work, &c., and it will give the reader some idea of the extent of the business done in arc lamps, when we say that there are never less than 3,000 lamps in stock and in progress at their Chelmsford works.

Fig. 7 shows a special arc lamp carrier with swinging frame to make the lamp easily accessible for cleaning and recarboning purposes. This design of arc lamp carrier is specially adapted for use with the patent insulated top which has been used by Messrs. Crompton & Co. for street lighting purposes with satisfactory results.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

8. "The Duo incandescent (electric) lamp." J. ISHERWOOD. January 1st.

18. "Improvements in and connected with electric tramcars and the like." J. H. PETERS and L. PETERS. January 1st.

21. "Improvements in and relating to electric tramways or street railways." H. S. COWX. January 1st.

53. "Improvements in or relating to electric relays or the like." P. PICARD. January 1st.

77. "Improvements in the method and means of registering the consumption of electric current, or other forms of energy developing heat." E. S. ISHAM, Jnr. January 1st. (Complete.)

102. "Improvements in Nernst lamps." S. GOWAN and THE NERNST ELECTRIC LIGHT, LIMITED. January 2nd.

106. "An improved electrical indicator." D. WELLS. January 2nd.

117. "Improvements relating to overhead tramway, telegraph and telephone wires." J. T. PEARSON. January 2nd.

118. "Improvements in or relating to anodes for electrolytic operations." M. D'AUDRIMONT. January 2nd. (Complete.)

120. "The electric car trolley guide." J. REYNOLDS. January 2nd.

146. "A method of utilising two conductors and earth for transmitting a number of different electrical communications." C. M. JACOBS and A. H. NICHOLSON. January 2nd.

173. "Improvements in and relating to electric lighting arrangements, particularly applicable for railway trains." F. W. SCHNEIDER and A. STRAUSS-COLLIN. January 2nd.

185. "Improvements in electric resistances." W. DU B. DUDDELL and T. MATHER. January 3rd.

189. "Improvements in and relating to trolley pulleys for overhead electric traction." W. B. DIXON. January 3rd.

239. "Improvements in electrical transformers for polyphase currents." A. F. BERRY and THE BRITISH ELECTRIC TRANSFORMER MANUFACTURING COMPANY, LIMITED. January 3rd.

252. "A new and improved switch, suitable for high voltage electric currents." J. W. HINTZE. January 4th.

303. "Improvements in circuit closers for portable electrical apparatus." W. ROCHE. January 4th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900.

2,883. "Improvements in hydrocarbon motors, chiefly designed for motor vehicles and the like." Soc. Anonyme d'Electricte et d'Automobiles Mors. Dated February 13th, 1900. The engines are designed for propelling motor road vehicles, and have four cylinders and cranks. The angular position of the exhaust and igniting cams on the shaft is adjusted by a centrifugal governor, which moves a sleeve in an axial direction, which sleeve has projections engaging with a helical groove in the shaft. Or the governor may alter the angular position on the crankshaft of the pinion that drives the countershaft. A float-controlled oil reservoir has four passages leading to nozzles in the air pipes which supply the four cylinders. The air current is controlled by a sliding valve.

2,897. "Improvements relating to tramways on the surface contact system." W. Chapman. Dated February 13th, 1900. Electric railways and tramways on a surface contact or like system with electro-magnetic switches in which the various conductors and connections are duplicated so that one set acts as a reserve.

2,929. "Improvements in electrolysers." W. T. Chapman and W. E. Batt. Dated February 14th, 1900. The anode carbon rod and the copper conducting rod are connected together by a block of antimonial lead cast upon them. The upper portion of the rod is screw threaded, while the lower is covered with a material such as sheet lead, which will not be acted upon by chlorine gas. The anode is adjustably supported so that it can be lowered as it becomes worn away, by means of a nut screwed on the rod and bearing upon the cover of the cell a gas-tight joint being formed around the rod by cement. The cement seal is broken and re-made each time the anode is adjusted in position.

2,994. "An improved process for the electrolytic treatment of nickel or its allied metals or alloys of the metals." M. Kugel. February 14th, 1900. Nickel cobalt and alloys, depositing. Nickel having toughness, durability and capability of extension equal to rolled nickel, is deposited by employing a nickel salt electrolyte heated to at least 80° C., and maintained in an acid condition by the addition of a strong mineral acid which is not chemically changed by the current, such as sulphuric, perchloric or perbromic acid. To prevent the acidity from diminishing during use, there is added a highly-concentrated solution of a salt of the acid used and of a light metal, which is not changed by the current, magnesium salts being suitable. The process may be used to obtain nickel printing-blocks, and may be also employed for depositing metals allied to nickel, such as cobalt, or alloys of such metals, such as German silver. Ores may be used as anodes, or be immersed in the electrolyte when using insoluble anodes, so as to obtain nickel or allied metals direct from the ores. In all cases the electrolyte is kept well mixed. A current up to 10 to 20 amperes per square decimetre may be used.

3,031. "Improvements in electricity meters." C. W. Little. Dated February 15th, 1900. Energy meters.—A counting mechanism is driven by a friction ratchet gear from a shaft while this is returning under the action of a pinion and a weighted toothed lever after being driven in the opposite direction by a short impulse from an arm on the spindle of a wattmeter, the pressure current to which is supplied periodically by a clock switch.

3,056. "Improvements in electric meters." V. I. Feeny. Dated February 15th, 1900. A registering meter for a three-phase three-wire system, consists of a spindle geared to a counter, and carrying two conductive discs, which are acted on by a brake magnet and three independent three-pole electro-magnets, such as are described in Specification No. 683, A.D. 1900. Each electro-magnet has series coils connected in its proper supply main, and shunt coils connected between this main and the next one in order.

3,105. "Improvements in systems of electrical distribution." L. Read, W. B. Read, and E. H. Farrar. Dated February 16th, 1900. Relates to means for protecting a house or like circuit in the event of the service wire being charged with a dangerous current.

3,106. "An automatic electric circuit breaker." L. C. Read, W. B. Read, and E. H. Farrar. Dated February 16th, 1900. Relates to means for protecting a circuit from excessive currents particularly adapted for low tension distribution systems.

3,107. "An improvement in isolated alternating low tension systems of electrical distribution." L. C. Read, W. B. Read, and E. H. Farrar. Dated February 16th, 1900. Relates to a circuit breaker for preventing waste in a house or like circuit supplied from an alternating current system.

3,108. "Improvements in arc lamps." W. C. Johnson and A. Wunderlich. Dated February 16th, 1900. Arc lamps for alternating currents. A clutch has its regulating coil placed on a non-magnetic tube, in which the core slides, and within an iron yoke made up of iron plates, which are held together by rivets, and bored to fit the tube. The movable core consists or an aluminium tube, with projections for six radial slots, which are packed with soft iron strips. Two circular grooves in the core hold packing to slide in the tube. The core is connected by a spring with a dashpot piston, which carries the clutch. The invention is applicable to render the lamp described in Specification, No. 4,231, A.D. 1899, suitable for alternating currents.

3,124. "Methods of, and apparatus for, manufacturing coils for use in electrical instruments." E. Weston. Dated February 16th, 1900.

3,143. "Improvement in electric relays." E. W. Brown. Dated February 16th, 1900. Relays or repeating apparatus for use in telegraph or telephone systems are arranged with the outgoing and incoming line wires respectively connected to two coils wound over a primary coil, one end of which is connected to the core, the other end being connected through a battery to diaphragms. The diaphragms are of iron, and may be chemically treated or coated with lamp-black, or may have carbon granules between them and the ends of the core for producing a variable resistance. A sheath of magnets surround the coil. In the provisional specification the use of a cut-out is referred to.

3,144. "Improvements in or relating to telephones." E. W. Brown. Dated February 16th, 1901. Relates to a form of apparatus for use both as transmitter and receiver combined or separately. A laminated core is wound preferably with primary and secondary wires, of which the secondary is connected to line, and the primary is connected through the core and diaphragms with a battery. The secondary circuit may be omitted, and the primary circuit connected to line. The diaphragms are either chemically treated, or lampblack or granulated carbon is employed to form a microphone. The whole, with polarising magnets, is mounted in a metal case, in which the tubes leading to the mouthpiece are pivoted. A tube is provided at one end with a contact for cutting in the battery when the instrument is in use.

3,174. "Improvements in and connected with long-distance telephony." M. C. Mengis. Dated February 19th, 1900. Long-distance telephone systems are arranged with repeaters at intervals, and when several subscribers' circuits are arranged in one cable the repeating-stations are employed in series according to the number of subscribers.

3,192. "Improvements in electric batteries." A. de Castro and H. W. Schlomann. Dated February 17th, 1900. Primary and secondary batteries. In order to render batteries as light as possible, they are composed mainly of sailcloth or like material impregnated electrolytically in the manner described in Specification No. 2,703, A.D. 1900. Such batteries may be employed in connection with the accumulators described in Specification No. 25,641, A.D. 1899.

3,196. "A new or improved telegraph apparatus." L. Wojniowicz. Dated February 17th, 1900. Relates to apparatus for composing a telegraph message and transmitting the same automatically. The various letters of the Morse code are formed as metal type having the surface broken up with insulating material so as to produce the required makes and breaks of the current. Such type are composed in grooves in a metal frame or plate divided up with insulating partitions.

3,203. "Improvements in interrupters for electric circuits." J. Lecarme and L. Lecarme. Dated February 17th, 1900. Interrupters for use in Hertzian radiations, &c. The frame is of iron, and supports the bobbins. Within the core slides an iron rod carrying a contact rod adapted to dip into mercury contained in a cup. In order to prevent splashing of the mercury, the rod is fitted with an extension of insulating material which always remains immersed. The upper end of the rod carries an extension fitted with a spring and the frame carries an adjustable rubber buffer against which the extension strikes. To prevent the rod from descending too far, it is fitted with a rubber washer adapted to strike a cross-piece. To minimise the undulations of the mercury, the mercury container may be made 8-shaped. To prevent sparking the terminals are connected by a fine wire and connected to a condenser.

3,237. "Improvements in electricity meters." Chamberlain & Hookham and S. H. Holden. Dated February 19th, 1900. A motor-meter has a conical or cup-shaped copper armature immersed in mercury, with its point or convex surface downward, to throw off air bubbles. The armature revolves in two magnetic fields between an iron block and pole-pieces on a long magnet; the mercury space is enclosed by a non-conducting ring, two pieces of non-magnetic material between the pole-pieces and a central plug. Current is conveyed to the armature by conductors passed through the ring, and the armature is retarded by eddy currents induced in it. In order to compensate for the diminution in these eddy currents when the resistance of the armature is increased by rise of temperature, a comparatively large resistance, made of material, such as iron, having a higher temperature resistance coefficient, is connected in series with the armature, and the whole is shunted by another resistance made of material having a lower coefficient, such as mangamin or platinoid. Thus, when the temperature rises, a smaller proportion of the main current passes through the armature to drive it. The meter is a modification of those described in Specifications Nos. 14,239, A.D. 1892, and 2,683, A.D. 1896. Resistances.—The provisional specification mentions the use of amalgams for the shunt resistance. Motor-meters of any kind having eddy current brakes may have the temperature errors of these compensated by the means above described. In some cases the series resistance must have a low temperature resistance coefficient, and the shunt a high one.

3,258. "Improvements in electric switches." A. F. Spooner. Dated February 19th, 1900. A flat spring is connected to one terminal, and a disc mounted on a stem is connected to the other through a plate and supports. Fitted on the stem is a disc having inclines which work against similar inclines on the plate supported by the supports. On turning a key the disc is forced down by the action of the inclines.

3,264. "Improvements in and relating to the armatures of electric motors, specially applicable for use in meters for electric current." C. Perdrisat. Dated February 19th, 1900. Armatures.—The armature of an electric motor, specially applicable for use in an electric meter, is composed as a series of coils wound on independent sheet-iron cores arranged round an axis of rotation in such a manner that one pole of each core is in advance of the other pole of the same core. The two ends of each coil are connected to two successive contact pieces of the commutator, as in a Gramme winding. In the particular arrangement the cores are bent round so as to have both poles in the same diametral plane, but at different distances from the axis.

3,291. "Improvements in means for fixing electric incandescent lamps." A. Wierre. Dated February 19th, 1900. A plate is made with a circular opening, and two slots to receive the cap and side pins of a lamp, which is then turned so that the pins lie in two recesses in the underside of the plate, or of a projecting flange thereon. The lamp is held in place by two contact springs carried by terminals on an insulator. The holding plates may be fixed on a support in the form of a letter for a sign, or an ornament. The lamps are also applicable to scenery and footlights for theatres.

3,315. "Improvements in and relating to electric heating apparatus." A. G. Brookes. Dated February 20th, 1900. Air is passed through a casing by a fan by which it is thrown into contact with heating-wires coiled on a porcelain ring and tubes.

3,343. "Improvements in telegraphic, transmitting and translating arrangements." A. Muirhead. Dated February 20th, 1900. Relates to improvements in the arrangements of receiving and retransmitting siphon-recorder signals by local relay and other electrical and mechanical means for curbing and otherwise improving such signals. References are made to the following Specifications in various modifications and details:—No. 3,453 of 1862; No. 3,413 of 1893; No. 11,069 of 1894; No. 10,908 of 1897; No. 12,731 of 1898; and No. 7,525 of 1899. In one arrangement of the circuits the signals are retransmitted to the cable by curbing currents through contacts. Ordinary Post Office standard pattern relays may be employed, and a recorder may be placed in the retardation circuit. In other forms, the coil is double wound, one coil being in the retardation circuit.